Compressed Air Magazine

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MARCH, 1928

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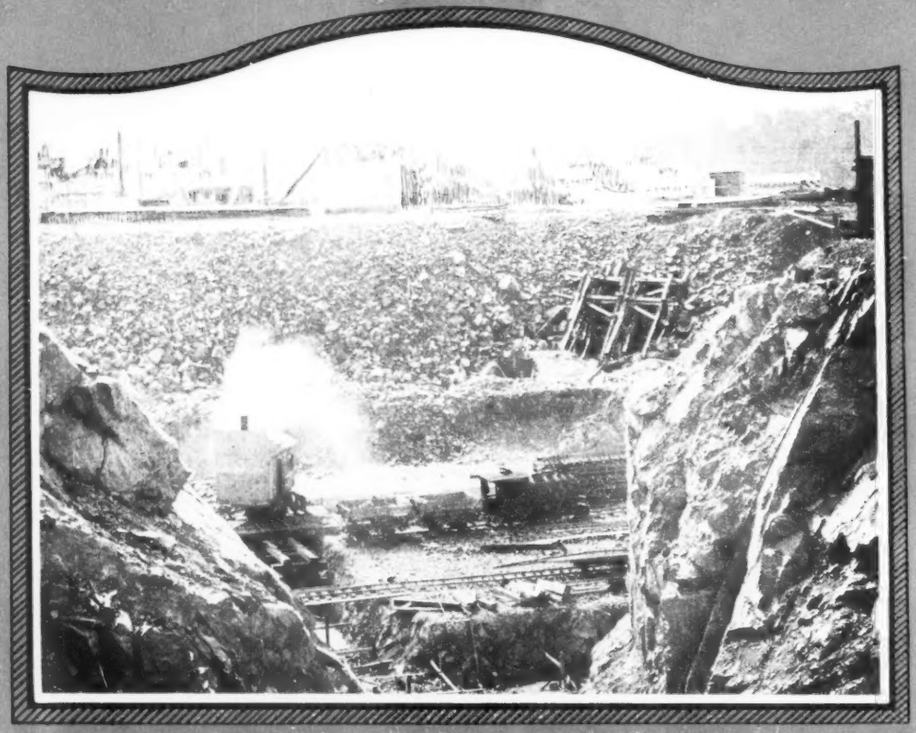


THE GREAT SONGHEES GRAVING DOCK AT ESQUIMALT, B. C., REQUIRED THE EXCAVATING OF MORE THAN 375,000 CUBIC YARDS OF ROCK

Waukesha Again Leads the Field

Among Heavy-Duty Engine Builders

At the Road Show at Cleveland this year, the exhibitors showing one or more power-driven machines with engines of the same or larger size, including Diesels, totaled more than 100. Nearly 30% were Waukesha equipped.

Names of Engine Builders who exhibited	*Percent of Exhibitors using engines of equivalent type or larger*
Waukesha	**28.6** ←
B	
C	
D	
E	
F	
G	
H	
I	
J	
K	
L	

Sold on Performance

Backed by Reputation

N-814-L

INDUSTRIAL EQUIPMENT DIVISION

WAUKESHA MOTOR COMPANY

Waukesha **Wisconsin**

New York	Kansas City	Denver	Tulsa	Houston	San Francisco
8 W. 40th St.	*F. L. Phillips Co.*	*Wilson Machy. Co.*	*C. F. Camp Co.*	*Portable Rotary Rig Co.*	*C. A. Watts*

Exclusive Builders of Heavy Duty Gasoline Engines for Over Twenty Years

I-R "Safety-First" Air Saw can be used for ripping boards, trimming, roofing, cutting concrete forms, etc.

"Sawing Wood"

On building or bridge construction work, an Ingersoll-Rand "Safety-First" Air Saw is the fastest and most efficient tool for sawing wood. Not only does it work ten times as fast as the ordinary hand saw, but it is much more flexible to use, cutting in any position whatsoever. A safety guard protects the operator at all times.

I-R "Safety-First" Air Saws are made with 6″, 8″, and 12″ diameter blades. These cut, respectively, to depths of 1½″, 2½″, and 4⅛″. The blades are supplied in cross-cut, rip, or combination cross-cut and rip types. They are easy to remove and replace.

One of the smaller Ingersoll-Rand Portables (5½″ x 5″) will operate three saws. Air power from the same compressor can also be used for operating I-R hoists, riveters, and woodboring drills.

Let us send you further details about these air saws and portable compressors.

INGERSOLL-RAND CO., 11 BROADWAY, NEW YORK CITY

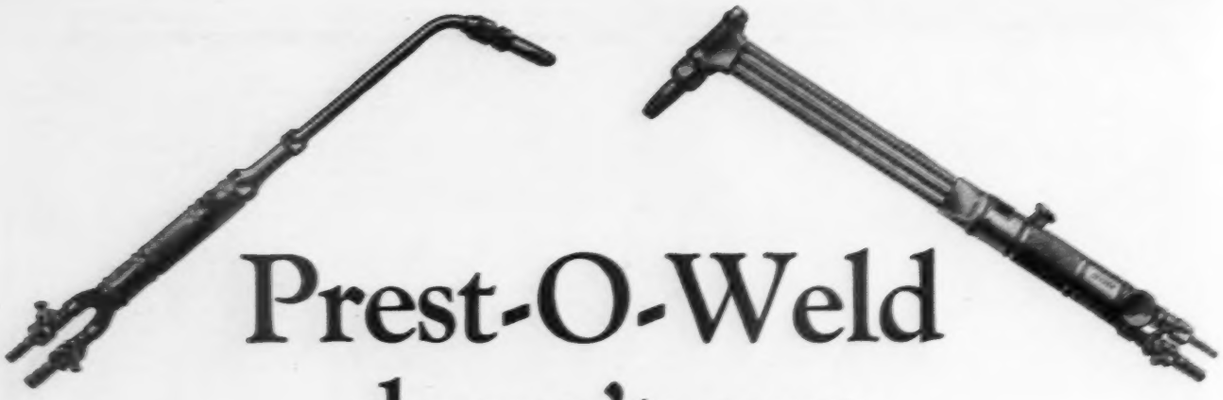
Offices in principal cities the world over

CANADIAN INGERSOLL-RAND CO., Ltd.
10 PHILLIPS SQUARE, MONTREAL, QUEBEC

INGERSOLL-RAND CO., Ltd.
165 QUEEN VICTORIA STREET, LONDON, E. C. 4

147 PC

Ingersoll-Rand



Prest-O-Weld doesn't pay interest— it pays principal

YOU hear a lot of people talking about interest on an investment.

A Prest-O-Weld outfit for oxy-acetylene welding and cutting doesn't pay interest. It pays principal. It pays back your expenditure and then keeps right on making a profit for you.

Prest-O-Weld is a good buy because it is reasonably priced and because it is well made (by the makers of the famous Oxweld blowpipes).

Sold by jobbers everywhere.

OXWELD ACETYLENE COMPANY
Unit of Union Carbide and Carbon Corporation

UCC

CHICAGO
3642 Jasper Place

NEW YORK CITY
30 East 42d Street

SAN FRANCISCO
1050 Mission Street

PREST-O-WELD

INTRODUCING

Oxweld C-14 cutting blowpipe

IF YOU are perfectly satisfied with your cutting blowpipes, don't ask to have the C-14 demonstrated.

Because—

Every time this new member of the Oxweld family is demonstrated, it makes a convert.

It has all the inherent advantages of the Oxweld injector type blowpipe.

It can be used with either low or medium pressure acetylene. And you can't make it back-fire.

OXWELD ACETYLENE COMPANY

UCC

Unit of Union Carbide and Carbon Corporation

NEW YORK CITY, 30 East 42d Street

CHICAGO, 3642 Jasper Place SAN FRANCISCO, 8th and Brannon Sts.

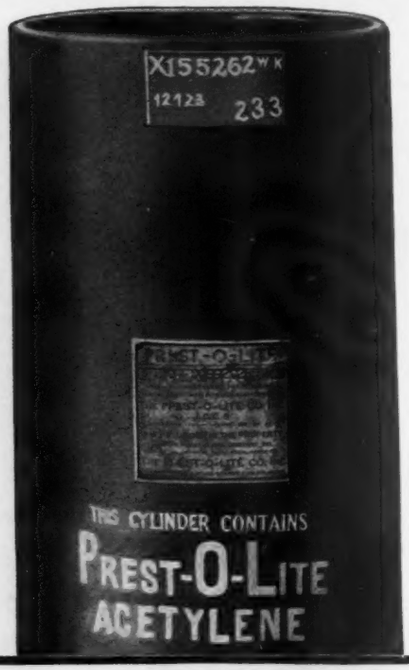
STOCKS IN 41 CITIES

IN CANADA, Dominion Oxygen Company, Ltd., Toronto

Oxweld

WELDING AND CUTTING APPARATUS

Eventually you'll standardize on Prest-O-Lite DISSOLVED ACETYLENE



Because one of the 139 Prest-O-Lite distributing points is near you.

Because over a period of 23 years this service has proved its reliability and economy.

THE PREST-O-LITE COMPANY, INC.
Unit of Union Carbide and Carbon Corporation

UCC

General Offices: Carbide and Carbon Building, 30 East 42d St., New York
37 Plants—102 Warehouses

10 DAY FREE TRIAL

Why the MULTIBLASTERS for Sandblasting and Painting serve a vital Commercial need HONESTLY, ADEQUATELY and ECONOMICALLY

1—First cost — lowest on the market.

2—Upkeep negligible.

3—Usages are manifold.

4—Indispensable wherever air under pressure is available.

5—Capacity virtually unlimited, viz:—only limited by size of sand supply, or, container utilized for liquids applied.

6—All Domestic Sales are on TRIAL BASIS (to prospective users only).

7—Most EFFECTIVE, DURABLE and COMPACT tools on the market for purposes intended — REGARDLESS of PRICE.

"THE MAN BEHIND THE GUN"
(Copyrighted)

A SAND BLAST as Powerful and Durable as the most costly, at

$30.00

A PAINT SPRAY that leads in Economy, Durability and Efficiency, at

$18.00

8—There is a type and size MULTIBLASTER for every operation of Sandblasting and Painting.

9—Thousands of MULTIBLASTERS sold to every industry, located from Coast to Coast and Abroad. Percentage of REPEATS is high.

10—The MULTIBLASTERS are the PIONEER PORTABLE tools for Sandblasting and for Painting.

There are 3 Types of MULTIBLASTERS (A type for Every Operation) { **for PAINTING and for SANDBLASTING** } Portable, No tanks, Efficient, Upkeep nil, Durable

GEORGE M. STOWE, Jr.

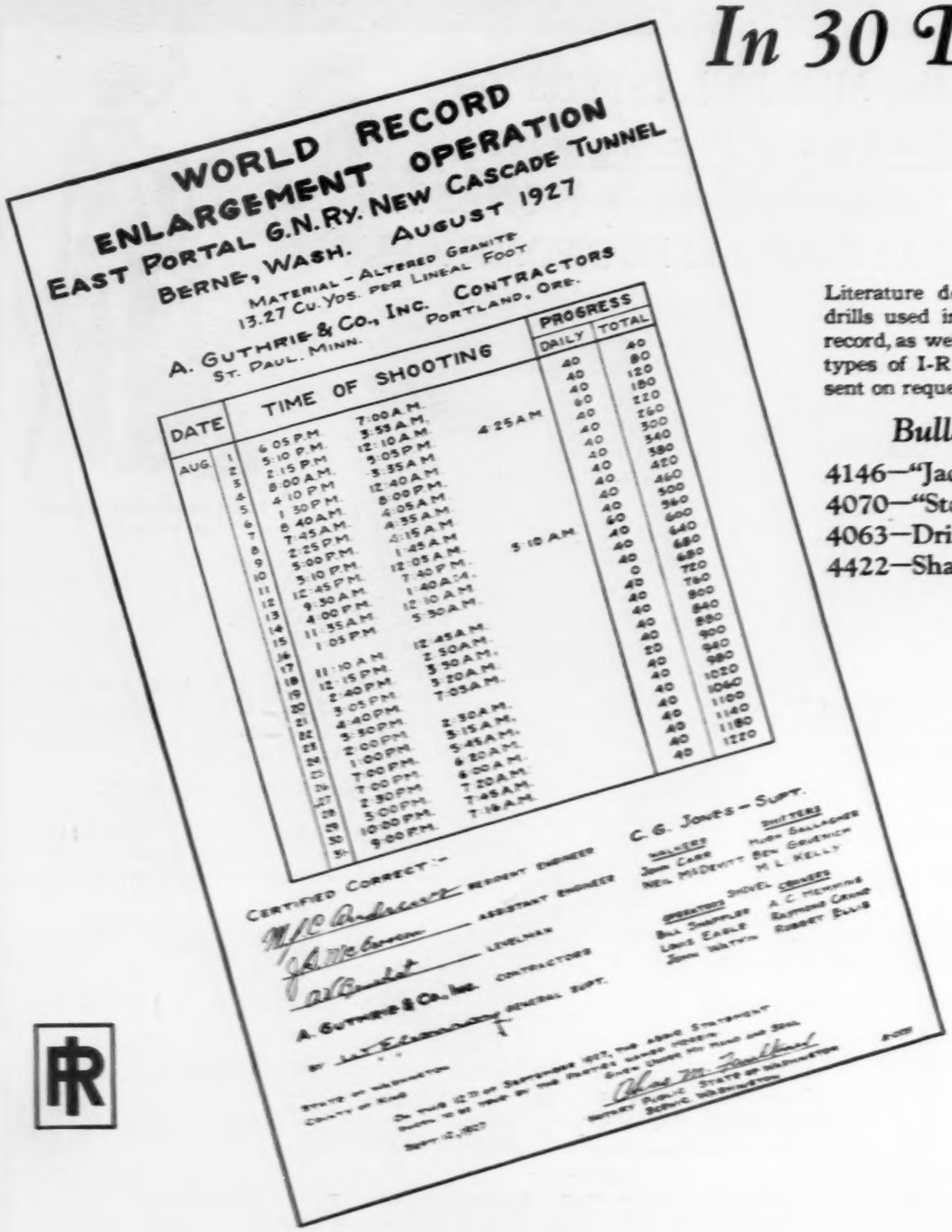
Manufacturer Since 1904

69 FOREST AVENUE **Cable Address "Multiblast"** **BUFFALO, N. Y., U. S. A.**

STOWE MULTI BLASTERS

REG. U.S. PAT. OFF.

1220 Feet of Tunnel Enlargement In 30 Days



WORLD RECORD
ENLARGEMENT OPERATION
EAST PORTAL G.N.RY. NEW CASCADE TUNNEL
BERNE, WASH. AUGUST 1927

MATERIAL – ALTERED GRANITE
13.27 CU. YDS. PER LINEAL FOOT

A. GUTHRIE & CO., INC. CONTRACTORS
ST. PAUL, MINN. PORTLAND, ORE.

DATE		TIME OF SHOOTING		PROGRESS DAILY	PROGRESS TOTAL
AUG	1	6 05 P.M.	7:00 A.M.	40	40
	2	5:10 P.M.	5:55 A.M.	40	80
	3	2:15 P.M.	12:10 A.M.	40	120
	4	8:00 A.M.	3:05 P.M.	60	180
	5	4:10 P.M.	3:35 A.M.	40	220
	6	1:30 P.M.	12:40 A.M.	40	260
	7	8:40 A.M.	8:00 P.M.	40	300
	8	7:45 A.M.	4:05 A.M.	40	340
	9	2:25 P.M.	4:35 A.M.	40	380
	10	5:00 P.M.	4:15 A.M.	40	420
	11	3:10 P.M.	1:45 A.M.	40	460
	12	12:45 P.M.	12:05 A.M.	40	500
	13	9:30 A.M.	7:40 P.M.	40	540
	14	4:00 P.M.	1:40 A.M.	60	600
	15	11:35 A.M.	12:10 A.M.	40	640
	16	1:05 P.M.	5:30 A.M.	40	680
	17		12:45 A.M.	40	720
	18	11:10 A.M.	2:50 A.M.	0	720
	19	12:15 P.M.	3:30 A.M.	40	760
	20	2:40 P.M.	3:20 A.M.	40	800
	21	3:05 P.M.	7:05 A.M.	40	840
	22	4:40 P.M.		40	880
	23	3:30 P.M.	2:30 A.M.	40	920
	24	2:00 P.M.	3:15 A.M.	20	940
	25	1:00 P.M.	5:45 A.M.	40	980
	26	7:00 P.M.	6:20 A.M.	40	1020
	27	7:00 P.M.	6:00 A.M.	40	1060
	28	2:30 P.M.	7:20 A.M.	40	1100
	29	5:00 P.M.	7:45 A.M.	40	1140
	30	10:00 P.M.	7:10 A.M.	40	1180
	31	9:00 P.M.		40	1220

C. G. JONES – SUPT.

CERTIFIED CORRECT:-
RESIDENT ENGINEER
ASSISTANT ENGINEER
LEVELMAN
A. GUTHRIE & CO. INC. CONTRACTORS
GENERAL SUPT.

HOLERS: JOHN CARR, NEAL MIDEVITT
SHIFTERS: HUGH GALLAGHER, BEN GRIENICH, M. L. KELLY
OPERATING SHOVEL: BILL SHAFFNER, LOUIE EAGLE, JOHN WATKIN
CRANES: A. C. HEWKINS, RAYMOND CRANE, ROBERT ELLIS

STATE OF WASHINGTON
COUNTY OF KING

ON THIS 12TH OF SEPTEMBER 1927, THE ABOVE STATEMENT WAS SIGNED AND SWORN TO BY THE PARTIES WHOSE NAMES ARE SIGNED UNDER MY HAND AND SEAL

NOTARY PUBLIC STATE OF WASHINGTON
RESIDING AT SEATTLE, WASHINGTON

Literature describing the drills used in making this record, as well as the other types of I-R drills, will be sent on request.

Bulletins:

4146—"Jackhamers"
4070—"Stopehamers"
4063—Drifters
4422—Sharpeners

There is an Ingersoll-Rand Branch near you. At this Branch you can obtain expert engineering assistance, competent mechanical service and prompt deliveries of complete machines and spare parts.

Atlanta	Duluth	New York	Cobalt	Havana	Durban	Melbourne	Semarang
Birmingham	El Paso	Philadelphia	Montreal	Mexico	Glasgow	Milan	Shanghai
Boston	Hartford	Pittsburgh	Nelson	Antofagasta	Iquique	Oruro	Soerabaja
Buffalo	Honolulu	Pottsville	St. Johns	Barranquilla	Johannesburg	Osaka	Stockholm
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Chicago	Knoxville	San Francisco	Sydney	Bombay	Kobe	Paris	The Hague
Cleveland	Los Angeles	Scranton	Toronto	Brussels	Lima	Rangoon	Tokyo
Dallas	Manila	Seattle	Timmins	Buenos Aires	London	Rio de Janeiro	Tucuman
Denver	Newark	St. Louis	Vancouver	Calcutta	Madrid	Santiago	Valparaiso
Detroit	New Orleans	Washington	Winnipeg	Copenhagen	Manchester	Sao Paulo	Vienna
						Secundee	Yokohama

View showing two Leyner-Ingersoll R-72 Drifter drills and one R-51 automatically rotated "Stopehamer" drill used in the enlargement work at the Cascade Tunnel.

New World's Record in Tunnel Enlargement

AN ADVANCE OF 1220 FEET in thirty days is the new record for tunnel enlargement. This record, made in August at the East Portal of the Cascade Tunnel, is 40 feet better than the previous record made in the same heading during July.

On this job, a 10′ x 10′ center heading was enlarged to 18′ x 26′. Ingersoll-Rand R-72 Drifter Drills mounted on columns were used for the bottom and side holes, while the automatically rotated Ingersoll-Rand R-51 Stopers were used for the top drilling.

The amount of rock removed in the 1220 feet of advance was approximately 16,189 cubic yards.

It is interesting to note that the new tunnel enlarging records being made month after month are all accomplished with Ingersoll-Rand Drills.

The work on this Great Northern Railroad tunnel is being done by A. Guthrie & Company, Inc., of St. Paul, Minn., and Portland, Oregon.

INGERSOLL-RAND COMPANY, 11 BROADWAY, NEW YORK CITY

Offices in principal cities the world over

For Canada Refer: Canadian Ingersoll-Rand Co., Limited, 10 Phillips Square, Montreal, Quebec

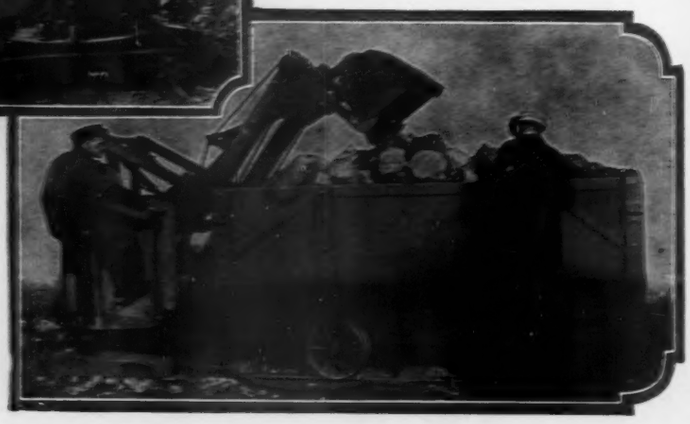
53 RDM

Ingersoll-Rand

FASTER DRIFTING

with the

Nordberg-Butler Underground Shovel



These three positions show the Nordberg-Butler Shovel with the dipper filled, elevated, revolved and dumped. Being of the full-revolving type, it will load cars at either side or behind. All the movements for the dipper are secured from one air cylinder and controlled from a single lever.

A SHOVEL built to meet the needs of the mining industry and to sell at a low price.

Here is a compact, light-weight, full-revolving shovel, built to meet the diversified needs of the mining industry. That it meets the requirements is best shown by its many successful installations and the repeat orders received from satisfied users. In many instances, big savings and increased output are being secured by the Nordberg-Butler Shovel. It is built compact enough to operate in drifts as small as 5½x7 feet, yet with its long dipper reach giving it a cleanup path of 18 feet, it is equally suitable for long rooms and stopes.

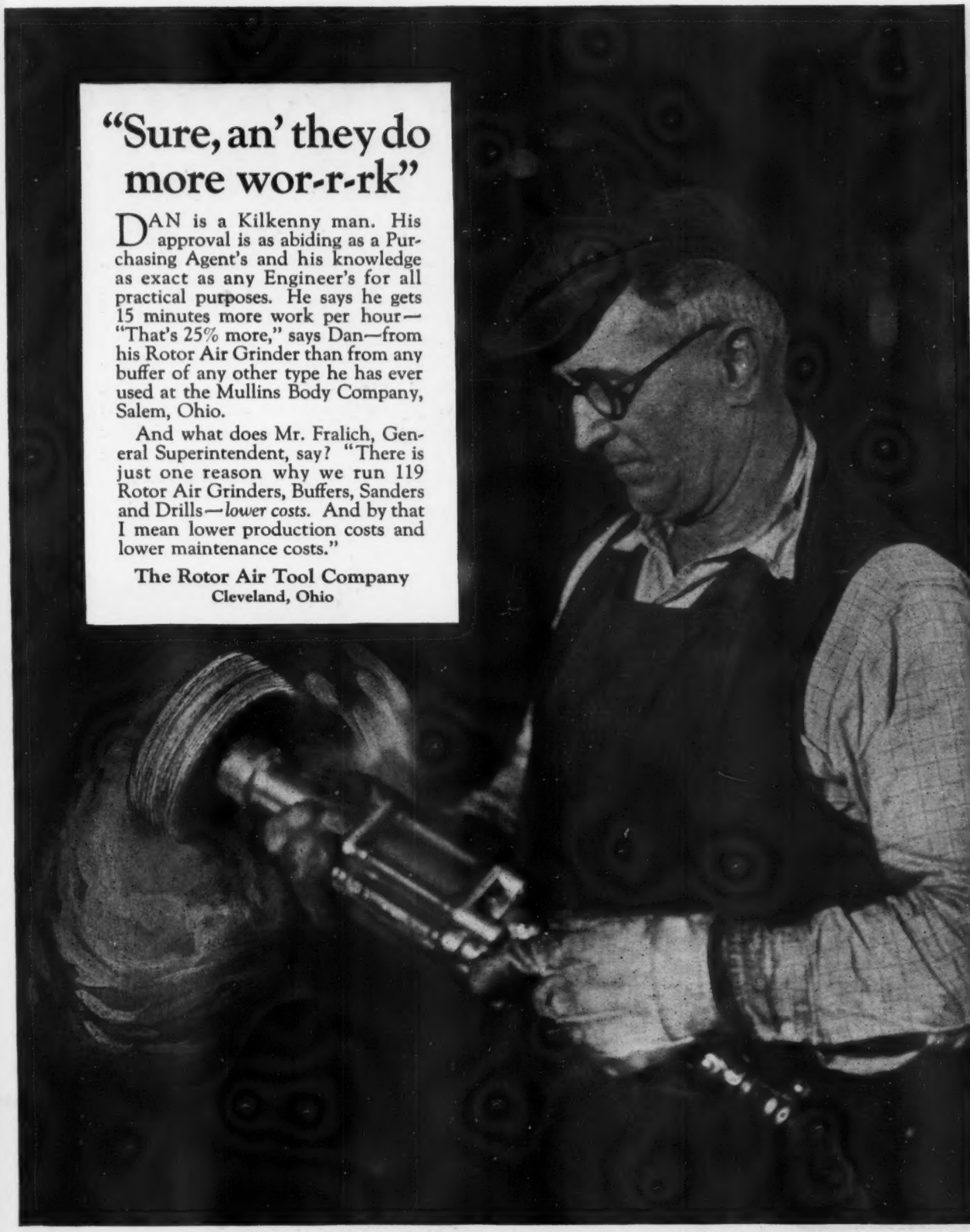
If it can be successful for others, it should perform in that same manner for you, even though you may think your conditions are different. Regardless of what your previous experience has been, the performance of this shovel will surprise you. If mechanical loading can be used, the Nordberg-Butler will serve you best.

Let us give you more particulars of how this Shovel will save you money on your mucking jobs. Described in Bulletin DR-8.

Nordberg Mfg. Co., Milwaukee, Wis., U. S. A.

Builders of Machinery for the Mining Industry

NORDBERG MACHINERY **NORDBERG** NORDBERG MACHINERY



"Sure, an' they do more wor-r-rk"

DAN is a Kilkenny man. His approval is as abiding as a Purchasing Agent's and his knowledge as exact as any Engineer's for all practical purposes. He says he gets 15 minutes more work per hour—"That's 25% more," says Dan—from his Rotor Air Grinder than from any buffer of any other type he has ever used at the Mullins Body Company, Salem, Ohio.

And what does Mr. Fralich, General Superintendent, say? "There is just one reason why we run 119 Rotor Air Grinders, Buffers, Sanders and Drills—*lower costs.* And by that I mean lower production costs and lower maintenance costs."

The Rotor Air Tool Company
Cleveland, Ohio

GRINDERS ' BUFFERS ' SANDERS ' DRILLS

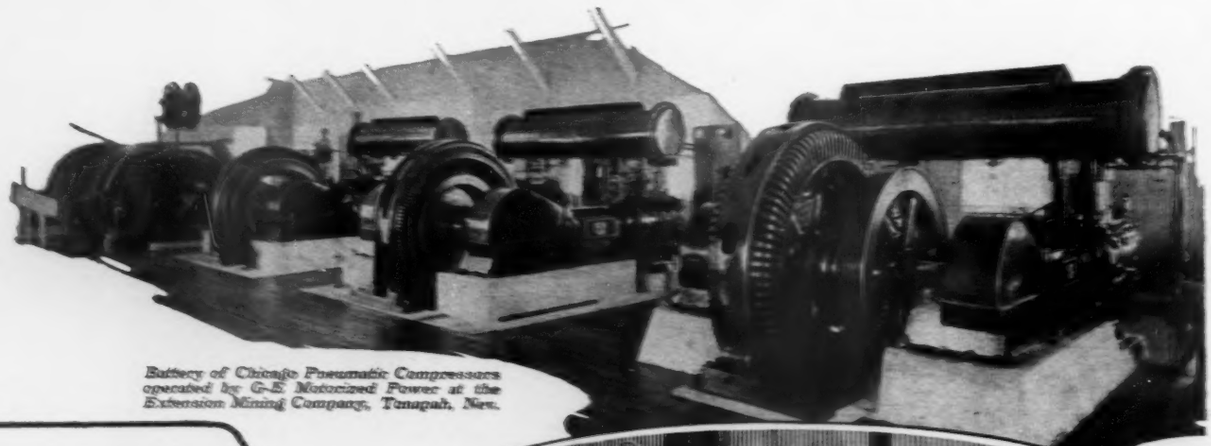
Rotor Air Tools

Air Compressing with G-E Motorized Power

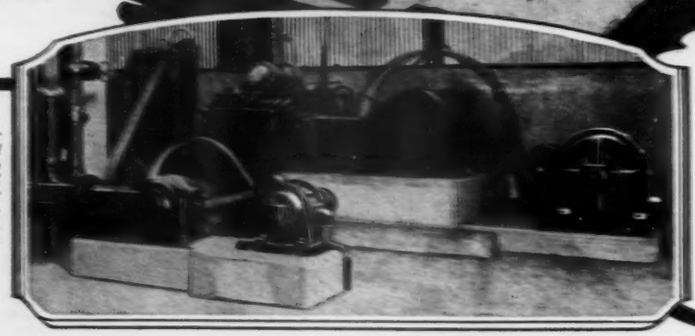
The bonanzas have gone, leaving the low-grade ore bodies that can be worked profitably only by the application of modern large-scale methods of mining and more efficient processes for recovering metals.

Much of the success of this modern mining is due to the use of compressed air for air-driven mining equipment, milling machinery, and smelting machinery. And much of the satisfaction and economy in the use of compressed air is due to the application of G-E Motorized Power to the compressors.

General Electric supplies a complete line of motors and controllers for all types and sizes of air compressors. The accompanying illustrations demonstrate that G-E apparatus is depended upon where continuous, reliable compressed-air service must be economically maintained—whether it be at one lb. for reverberatory furnaces or at 100 lb. for drills and general mine service.



Battery of Chicago Pneumatic Compressors operated by G-E Motorized Power at the Extension Mining Company, Tonopah, Nev.



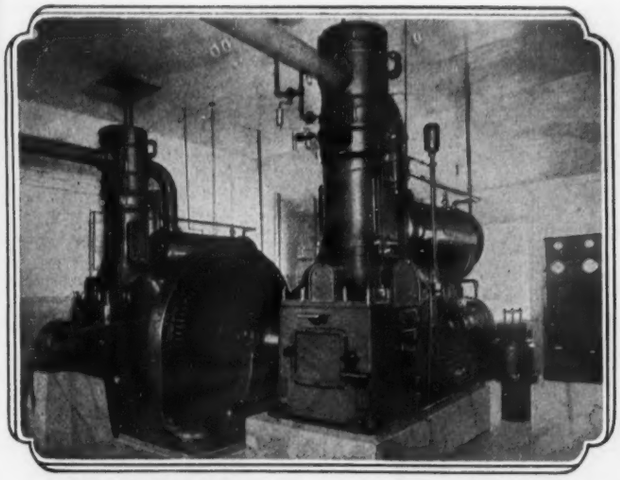
Worthington air compressor and vacuum pump operated by G-E Motorized Power at Chief Consolidated Mining Co., Eureka, Utah.

Apply the proper G-E motor and the correct G-E controller to a specific task, following the recommendations of G-E specialists in electric drive and you have G-E Motorized Power. "Built in" or otherwise connected to all types of industrial machines, G-E Motorized Power provides lasting assurance that you have purchased the best.

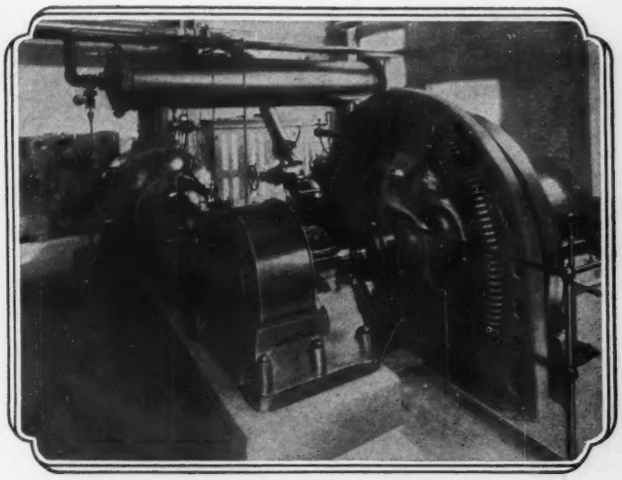
Motorized Power
—fitted to every need

GENERAL

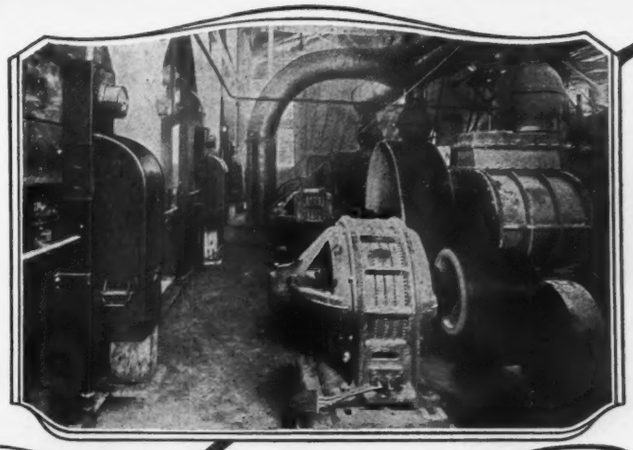
GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y.



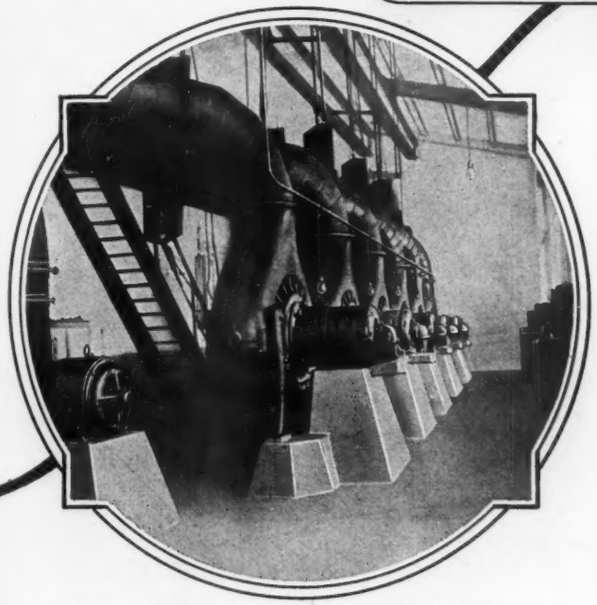
600-h.p. G-E Synchronous Motor operating a Sullivan compressor at Judge Mine, Park City, Utah



Ingersoll-Rand Air Compressor operated by G-E Motorized Power at Cleveland Cliffs Iron Co., Negaunee, Mich.



G-E Motorized Power operating Blowers at Utah Consolidated Mining Co., International, Utah



G-E Centrifugal Blowers operating at Washoe Reduction Works of the Anaconda Copper Mining Co.

COMPRESSING is only one phase of metal mine operation served by General Electric. Thorough electrification and G-E equipment combine to obtain high unit production and low unit costs also in

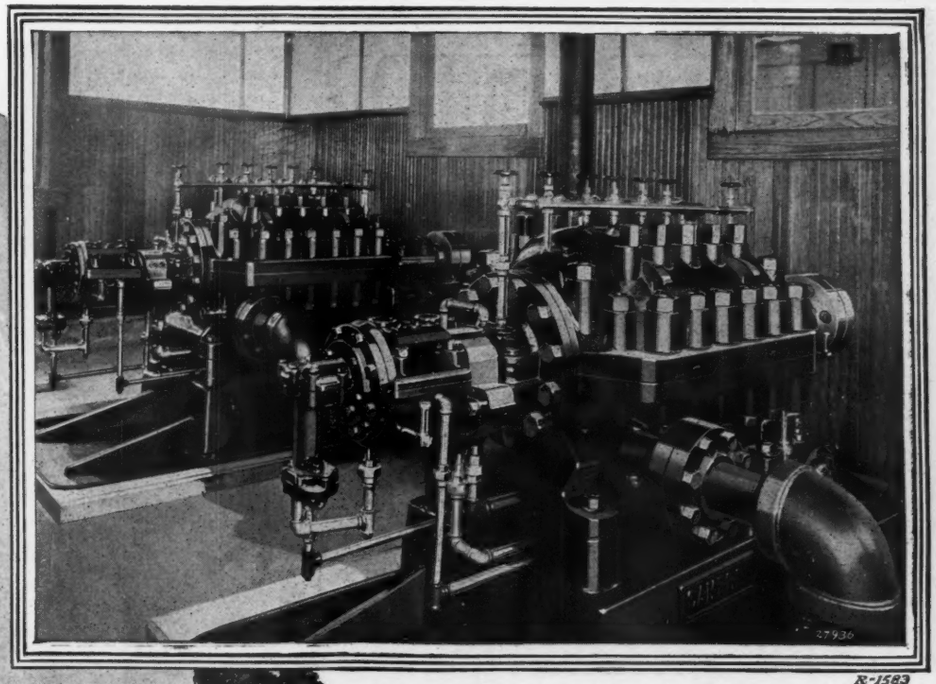
Tramming—Pumping—Hoisting—Stripping—Mechanical Loading—Ventilation—Milling—Smelting and Refining—Conveying—Power Generation—Power Distribution and Conversion—Etc.

Whatever the need, G-E meets it so dependably and economically that each General Electric installation recommends another.

107-11

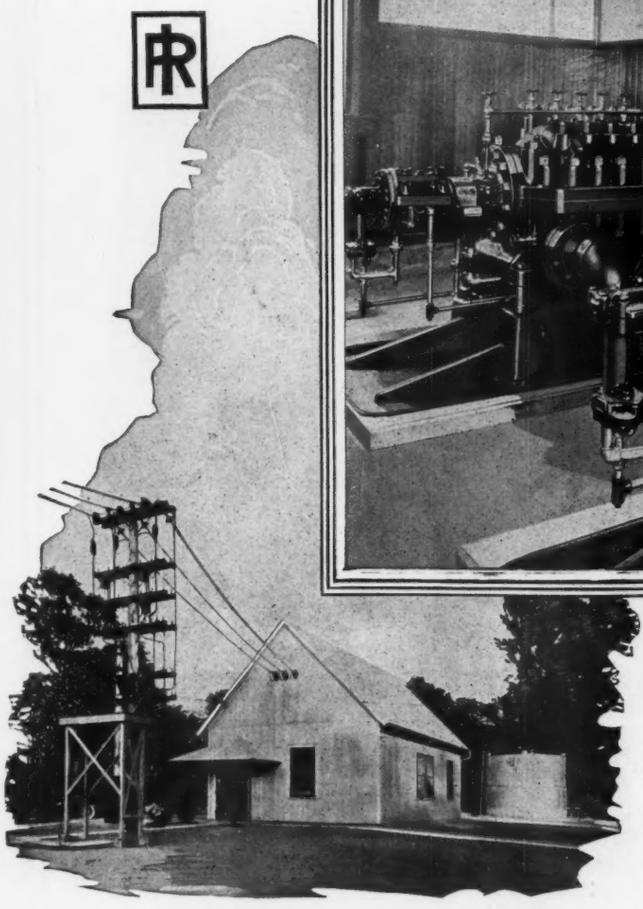
ELECTRIC

SALES OFFICES IN PRINCIPAL CITIES



R-1583

Typical installation of two Cameron electric-motor-driven centrifugal pumps in pumping station of the Illinois Pipe Line Company. Each one of these pumps is capable of carrying the full load of 22,000 barrels per day against a total head of 600 lbs. pressure.



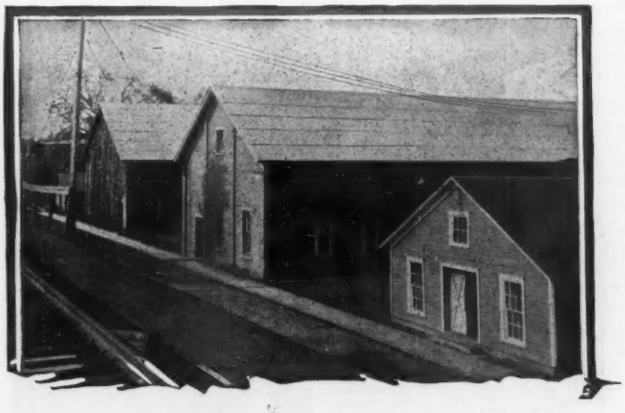
Typical intermediate pumping station erected by the Illinois Pipe Line Company for housing two Cameron electric-motor-driven centrifugal pumps, and a 1,000-barrel emergency storage tank.

Centrifugal Pumps in Pipe Line Service—

BY INSTALLING Cameron electric-motor-driven centrifugal pumps supplementary to the direct-acting steam pump stations, the Illinois Pipe Line Company has raised the capacity of a single 8-inch line from 15,000 to 22,000 barrels a day.

Small pumping stations, erected at intervals of 25 miles between established stations, send the oil flowing through the pipe line in a steady stream, free from surges, and this tends to lessen the occurrence of blown gaskets and leaks.

Cameron centrifugal pipe line pumps cost less to install and to maintain, and show marked operating economies over most other types of pumping plant used for the same service.



One of the old steam pumping plants of the Illinois Pipe Line Company.

A. S. Cameron Steam Pump Works
11 Broadway, New York City

Offices in principal cities the world over

Canadian Ingersoll-Rand Co., Limited, 10 Phillips Square, Montreal, Que.
Ingersoll-Rand Co., Limited, 165 Queen Victoria St., London, E. C. 4

293-DV

Cameron Pumps

PROTECTOMOTOR

REG. U. S. PAT. OFF.

Perfect Positive Protection

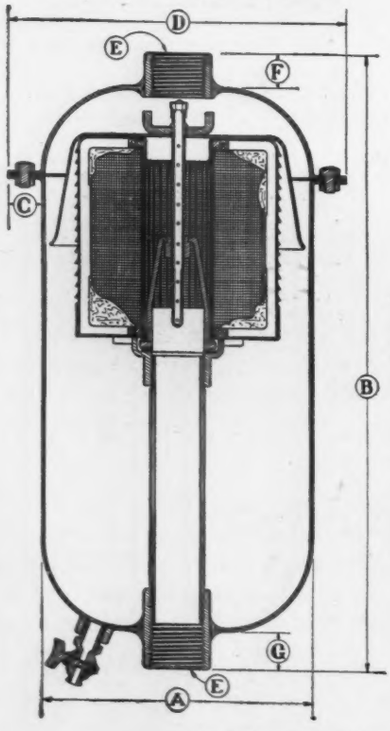
Industrial Air Filters

Are the most practical for every size and type of machine.

Simplicity of design, highest efficiency—99°/₁₀%, durability, freedom from attention and the fact that all models are shipped complete in weather proof housings with threaded or flanged connections accounts for the sale of

Over 250,000 In the Past 5 Years

Cross Section Pipe Line Filter



An Outstanding Achievement

The Model CP Pipe Line Filter is far superior to the traps or separators on the market in that it provides a positive high efficiency filter, in addition to the inertia or centrifugal principle of separation. Complete removal of all water, oil, iron rust, pipe scales and any other foreign matter is accomplished. A most important feature is that the filtering medium may be cleaned quickly and thoroughly by reversing the flow of the air.

These filters will deliver clean dry air for paint spraying, compressed air tools, hoists, cleaning operations, agitating liquids, ice-making, chemical processes, etc. We have made this type of filter as special equipment for the past three years. The increasing demand has made it desirable to offer them in the range of sizes shown.

Sectional View of the Model CP Pipe Line Filter

Specifications of Model "CP" Pipe Line Filters

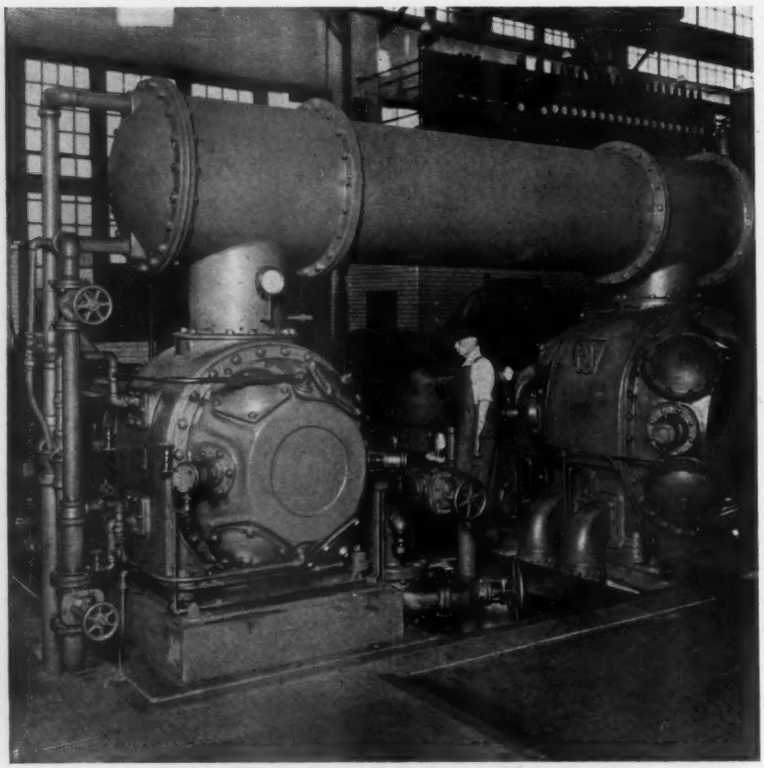
Size	A	B	C	D	E (Briggs)	F	G
CP-0	5"	11½"	¾"	6¾"	¾" S. P.	7/16"	13/16"
CP-1	6"	13 11/16"	¾"	7¾"	1 " S. P.	½"	15/16"
CP-2	7"	15 15/16"	¾"	8¾"	1½" S. P.	½"	1 3/16"
CP-4	8"	18 1/16"	¾"	9⅞"	2 " S. P.	½"	1 5/16"
CP-4A	9"	20 5/16"	¾"	10⅞"	2½" S. P.	⅝"	1 7/16"
CP-5	10"	22 7/16"	¾"	12 "	3 " S. P.	⅝"	1 9/16"

(Catalogue showing complete line on request)

STAYNEW FILTER CORPORATION

ROCHESTER, N. Y, U. S. A.

Thimblefuls vs. Tubfuls . . . .



The worst possible way to lubricate the air cylinders of an air compressor is to use an ordinary grade of oil and feed it in large quantities.

Excessive oil in an air compressor is swept off the cylinder by the compressed air; is deposited on the discharge valves and in the valve chambers, pipe lines and receivers; and, accelerates oxidation and forming of carbon deposits.

Never over-lubricate

The one important rule for correctly lubricating an air compressor is: *use a minimum-feed oil.*

The most widely recognized "minimum feed oil" is Gargoyle D. T. E. Oil Heavy Medium. The oil resists oxidation; reduces formation of carbon deposits; and is economical as well as safe to use.

Supplies of Gargoyle Lubricating Oils, uniform in quality, are always ready for prompt delivery from our warehouses in your section.

NOTE: On request we will send you, without obligation, our authoritative treatise, *Air Compressor Lubrication.* Write for your copy.

GARGOYLE

Lubricating Oils

A grade for each type of service

Vacuum Oil Company

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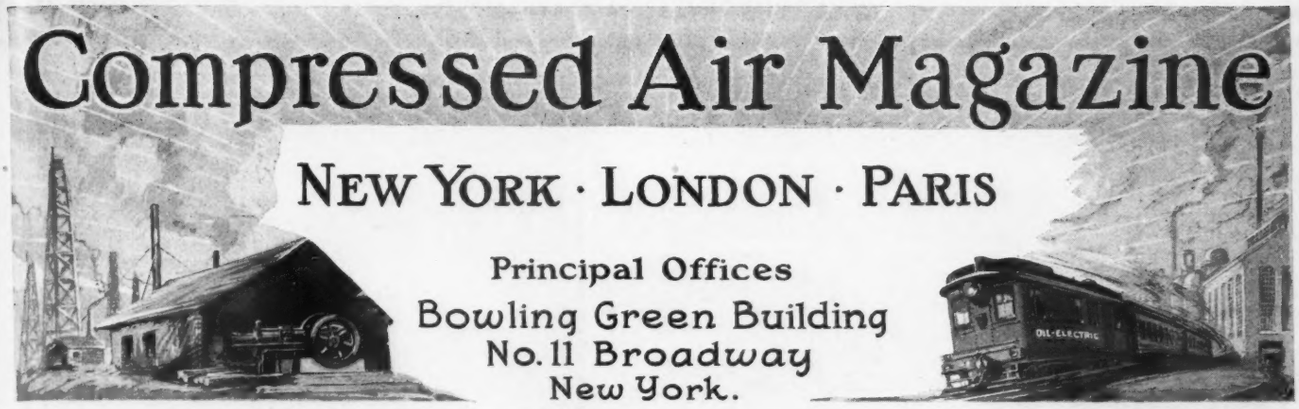

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Centrifugal Pumps Prove Superior For Oil-Pipe-Line Service

Experience of Illinois Pipe Line Company Discloses Great Operating Flexibilities Possible With Such Pumps

By R. G. SKERRETT

HOW to pump half again as much oil, at a limited pressure, through a single line was the problem that confronted the Illinois Pipe Line Company last year.

The situation was not analogous to that of passing a larger peg through a smaller hole. But it did mean the moving, in a given interval, of a greater volume of oil through a main of prescribed diameter; and it required that this be done without augmenting the initial pressure needed to keep the oil in motion.

What that alert and efficiently managed company did in order to amplify its service without altering its arterial system, so to speak, represents an engineering accomplishment of outstanding significance—outstanding because of the conspicuous part played by our pipe lines in transporting oil from the fields to more or less remote refineries and to the seaboard. Possibly, the meaning of what the Illinois Pipe Line Company has done will stand out more vividly if we sketch briefly the nature of the work performed by the pipe lines of the United States.

At the present time, our pipe lines handle nearly 90 per cent. of all the petroleum moved from the widely separated oil fields to distant points for refining or to tidewater for loading aboard tankers. Therefore, it should not be difficult to realize why the gathering lines and the trunk lines of this system have a combined length of approximately 100,000 miles. In the course of a year about 800,000,000 barrels of oil are conveyed from point to point through this interconnecting network of piping; and the industrial importance of this method of transportation becomes still more evident when one is reminded that oil can be moved by pipe line any given distance. Pipe lines are especially valuable in territory where no other transportation facilities exist. Accordingly, any improvement that tends towards economy in pipe-line service looms large when viewed in the light of the measure of service rendered by that system of conveyance—sometimes picturesquely termed the "underground railway."

NEARLY ninety per cent. of all the oil moved from fields to refineries or to tidewater for shipment is handled by the country's far-flung pipe-line system. The rapidity with which oil can thus be transported is a matter of much economic importance.

Therefore, anything that makes it practicable to obtain a still greater volume of service from a given trunk line is something of outstanding significance—concerning, as it does, a department of the oil industry in which hundreds of millions of dollars are invested.

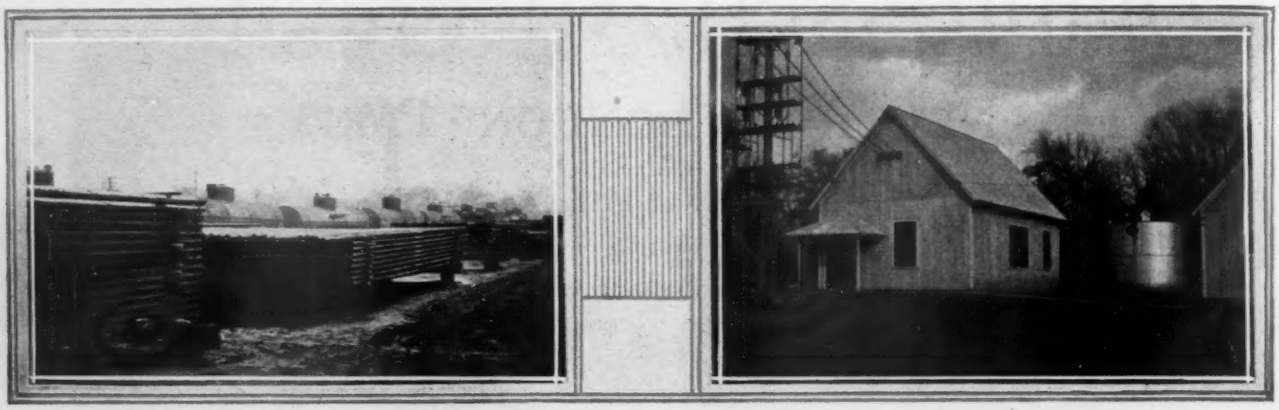
The accompanying story describes what was recently achieved by the Illinois Pipe Line Company through the adoption of electrically driven pumps in place of steam-driven reciprocating pumps.

The expansion of our pipe-line system and the growth of its service have been notably pronounced in recent years because of the ever-increasing output of our oil fields. It is interesting to recall that the moving of oil from its sources in this manner had a very modest beginning in 1865, when Samuel Van Sickle built the first successful pipe line for the transportation of crude petroleum. That line, made up of 2-inch pipe, extended for a length of four miles from Miller's Farm, Pa., to a convenient point on the Allegheny River, whence it was shipped by boat to Pittsburgh.

The main trunk line of the Illinois Pipe Line Company runs in a northeasterly direction from the town of Wood River, Ill., on the Mississippi River, to Negley, Ohio, on the Pennsylvania-Ohio state line. That is to say, this trunk line crosses Illinois, Indiana, and Ohio for a distance of approximately 561 miles, and serves as a connecting link between the Prairie Pipe Line Company, on the west, and the pipe line of the Tuscarora Oil Company, Ltd., on the east. Between these extremes, at Lima, Ohio, the Illinois Pipe Line Company's system hooks up with the trunk-line system of the Buckeye Pipe Line Company. In 1926 the Illinois Pipe Line Company acquired the lines of the Indian Pipe Line Corporation, with a gathering system reaching into the Kentucky oil fields and a trunk line extending to Lawrenceville, Ill. The company also owns and operates pipe lines in Wyoming, Montana, and New Mexico; and it has constructed and is adding to its lines in Texas.

Efficiency is the keynote of the operating policy of this progressive company; and to enable it to move oil more expeditiously and more economically with the least practicable stress upon its lines the company has latterly been engaged in making notable changes in its pumping-station equipment.

Until a few months ago, the Illinois Pipe Line Company relied upon pumping stations placed on an average of 50 miles apart. At each of these main stations there is a big tank capable of holding 35,000 barrels of crude oil, and heretofore these tanks were connected



Left—Stocks of piping in a new oil field in readiness for the extension of a pipe line.
Right—A typical intermediate pumping station equipped with electrically driven centrifugal pumps.

to the main pumping line and could be used as combination surge tanks and storage tanks, if so desired. By relays, the oil was moved from station to station—finally entering another pipeline system or coming to a halt in the reservoirs of a terminal tank farm. The pumps provided for this purpose—as has so generally been the case in the past—were steam-driven, reciprocating pumps of large capacity. To be exact, the steam pumps in question were able to maintain on the oil as it entered the forwarding line an initial pressure of from 575 to 600 pounds per square inch; and with that equipment the company handled, in the course of a 24-hour day, a matter of 15,000 barrels of oil.

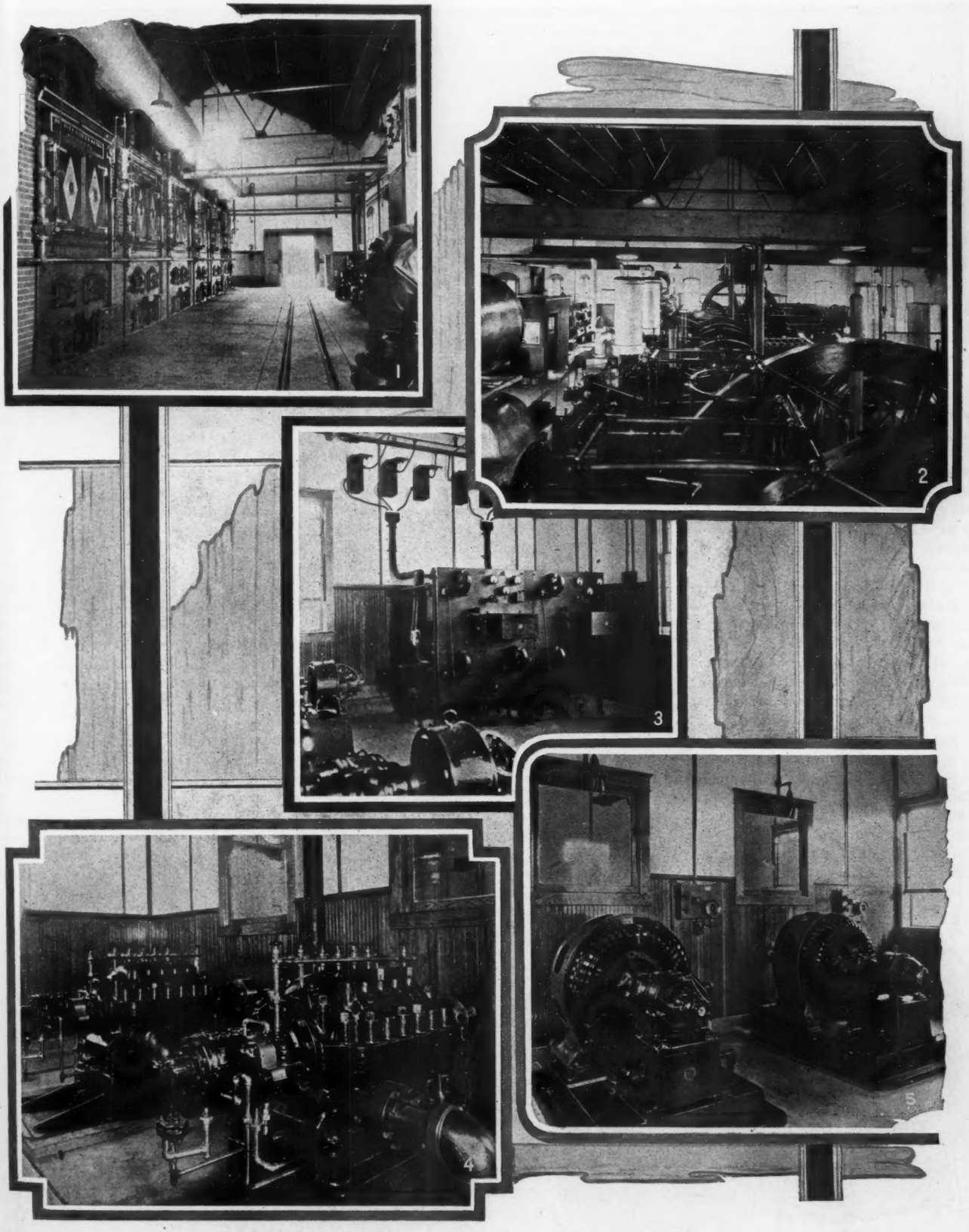
The steam plant at each of these primary stations has been much larger than necessary to handle 15,000 barrels of oil a day, and consisted of six boilers, each of 75 hp., of which only a few were in use. The pumping plant has been a battery of large pumps capable of providing reserve units to meet an emergency and to handle all the oil that could be forwarded through the company's trunk lines. In 1926, when the demand dropped somewhat, a single 8-inch line—then being in service on that part of the trunk line between Lima and Negley—was found to be of sufficient capacity to distribute the volume of oil reaching the company's system. During the past year, however, a demand developed for a greater carrying capacity than 15,000 barrels a day; and the Illinois Pipe Line Company was confronted with the problem of devising means by which it might increase its service by nearly 50 per cent.—using the single 8-inch section of the trunk line and keeping the initial pressure at or below 600 pounds.

Briefly stated, the solution of the problem consisted primarily of erecting intermediate pumping stations along this section of 8-inch line, thus giving the oil in transit a new start every 25 miles on its relayed journey. In each of these stations were placed two electrically driven centrifugal pumps—one pump serving as a stand-by unit, and either pump being of ample capacity to handle 22,000 barrels of oil during a 24-hour day. By cutting down the interval between successive stations to 25 miles, the unit load to be moved—that is, the total weight of oil in one section of the line—was reduced to half the weight formerly moved. This lightening of the load made it practicable to increase the velocity of flow between the stations without augmenting the impulse pressure at each pumping station.

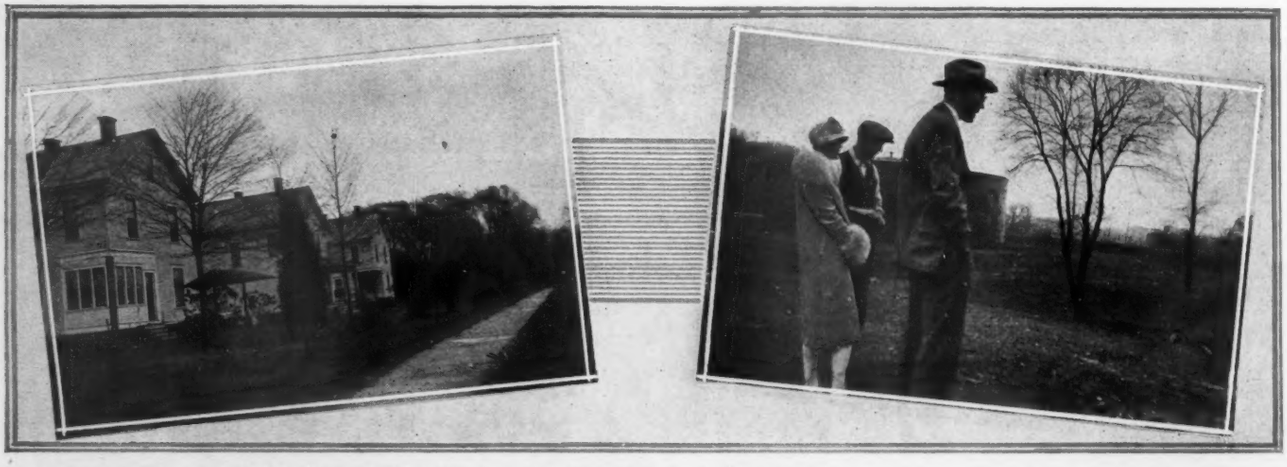
It might seem that this amplification of pumping facilities would swell disproportionately both overhead and operating expenses, and someone may ask: Why not build a second 8-inch pipe line to make use of the pumping facilities already available? The answer is that the construction of such a line would probably cost on an average $8,000 a mile. Such being the case, possibly someone else may query: Why not put steam-driven reciprocating pump stations at the intermediate points, utilizing the same sort of equipment heretofore provided? This question can be answered only at length.

The differences between the action on the oil of the reciprocating and the centrifugal pump may be broadly explained as follows: The centrifugal pump sends the oil forward in a

Left—The 1,000-barrel tank that has taken the place of the 35,000-barrel oil tank at the Coulter Pumping Station.
Right—Small bolted tanks are used in some new oil fields to hold petroleum until it can be carried away by railroad or pipe line.
Bottom—Temporary feeder lines running from oil wells to tanks.



1—Boilers at the Coulter Pumping Station.
2—The steam-driven reciprocating pumps just before they were removed from the station at Coulter.
3—Switchboard of a plant where electrically driven centrifugal pumps are installed.
4—Each of these motor-driven Cameron pumps is capable of handling 22,000 barrels of oil a day. One pump serves as a stand-by unit when the other is in service.
5—Each centrifugal pump is driven by a Westinghouse synchronous motor. The motors and the pumps are in separate rooms as a fire-prevention measure.



Left—Homes for personnel of the Coulter Pumping Station, Perrysville, Ohio.
Right—Visitors interested in preparations for burning a large accumulation of emulsion, commonly known as "B. S."

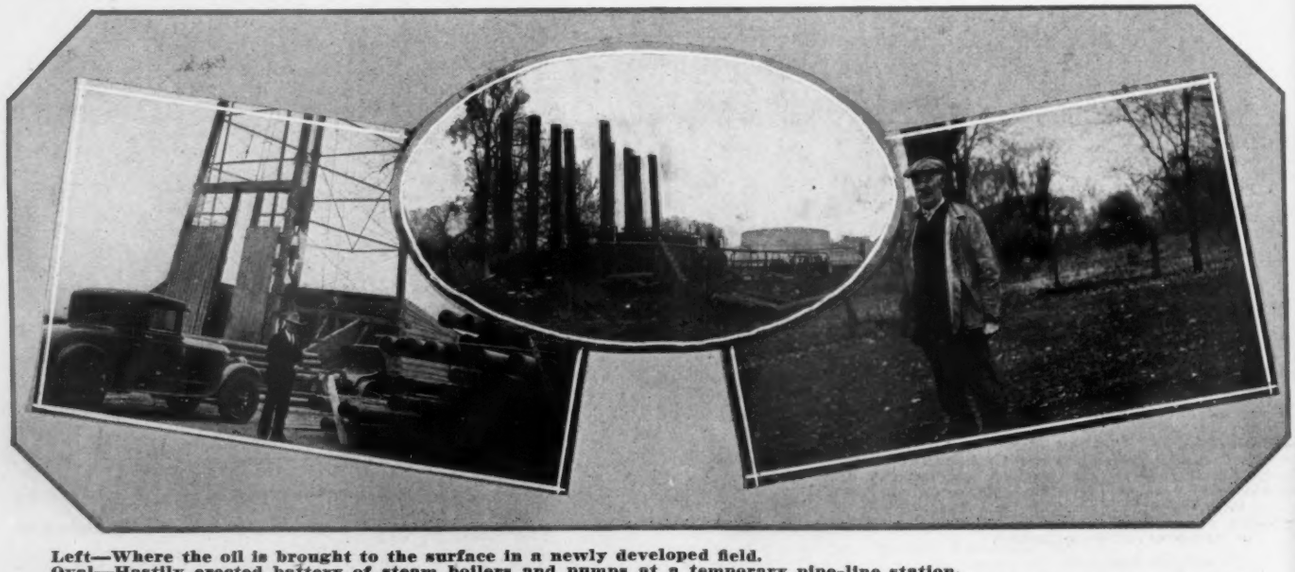
steady stream without any of the pulsations characteristic of a reciprocating pump. This smoothness of movement or constant stream of flow from the centrifugal pump has a tendency to lessen the occurrence of blown gaskets and leaks in the line. The pipe-line company has to pay for all losses in transit just as does any other common carrier. Furthermore, the oil is not emulsified by the centrifugal pump as it is by the reciprocating pump.

The absence of emulsification in the case of the centrifugal pump leads to operating economies of considerable moment. An added advantage of the centrifugal pump is the much lower stand-by loss when such a pump is driven by an electric motor. For instance, when a station designed to handle 20,000 barrels a day has but 5,000 barrels to pump a day it is entirely practicable to run that station at full capacity for only six hours, and then to shut down completely. In a steam plant, however, the stand-by losses are nearly as great as the cost of steady operation. Furthermore, pumps driven by triple-expansion steam engines, such as are extensively employed, are virtually useless when called upon to handle small quantities of oil because they cannot run slower than at a certain minimum speed without stalling and giving trouble.

A steam pumping plant, such as heretofore in use in the prime pumping stations along the trunk line of the Illinois Pipe Line Company's system in Illinois, Indiana, and Ohio, represents an outlay of about $200,000 at the lowest likely figure, while the cost of electrically driven centrifugal pumps of ample capacity, including buildings, will probably not exceed $30,000. The difference is a matter of first consideration, because pipe-line companies are taxed by State and Federal governments upon the basis of installed valuation.

There is another aspect of this question that should be taken into account in evaluating the two systems of pumping oil in any pipe line. Let us make this clear. Under widely prevailing operating conditions, Station No. 1, let us say, pumps oil tc a 35,000-barrel tank at Station No. 2; and Station No. 2 withdraws the oil from this tank and delivers it through intervening piping to a similar tank at Station No. 3. In this way the oil goes forward to the end of the system. Each of these big and expensive tanks performs the function of a surge tank to prevent overcrowding the associate pumping plant at that point; and experience generally has shown that, whenever reciprocating pumps are employed, it is unwise for one pumping station to deliver directly to the pumps in the next station, except where the volume and the pressure of the arriving oil can be very carefully controlled. In practice Cameron centrifugal pumps have been found to possess the exceptional ability of handling viscous oils in high-suction lifts up to 20 inches of vacuum. Anybody familiar with pumps in pipe-line service will appreciate the significance of this.

These large tanks are, therefore, commonly required when reciprocating pumps are used because more oil per minute can be pumped without inconvenience, into these tanks than the withdrawing pump or pumps may be sending forward to the next station. When centrifugal pumps at two stations are hooked up directly, as they can be, then they, as well as



Left—Where the oil is brought to the surface in a newly developed field.
Oval—Hastily erected battery of steam boilers and pumps at a temporary pipe-line station.
Right—Edward Kaffer, superintendent, who is proud of his new equipment at the Coulter Pumping Station at Perrysville.

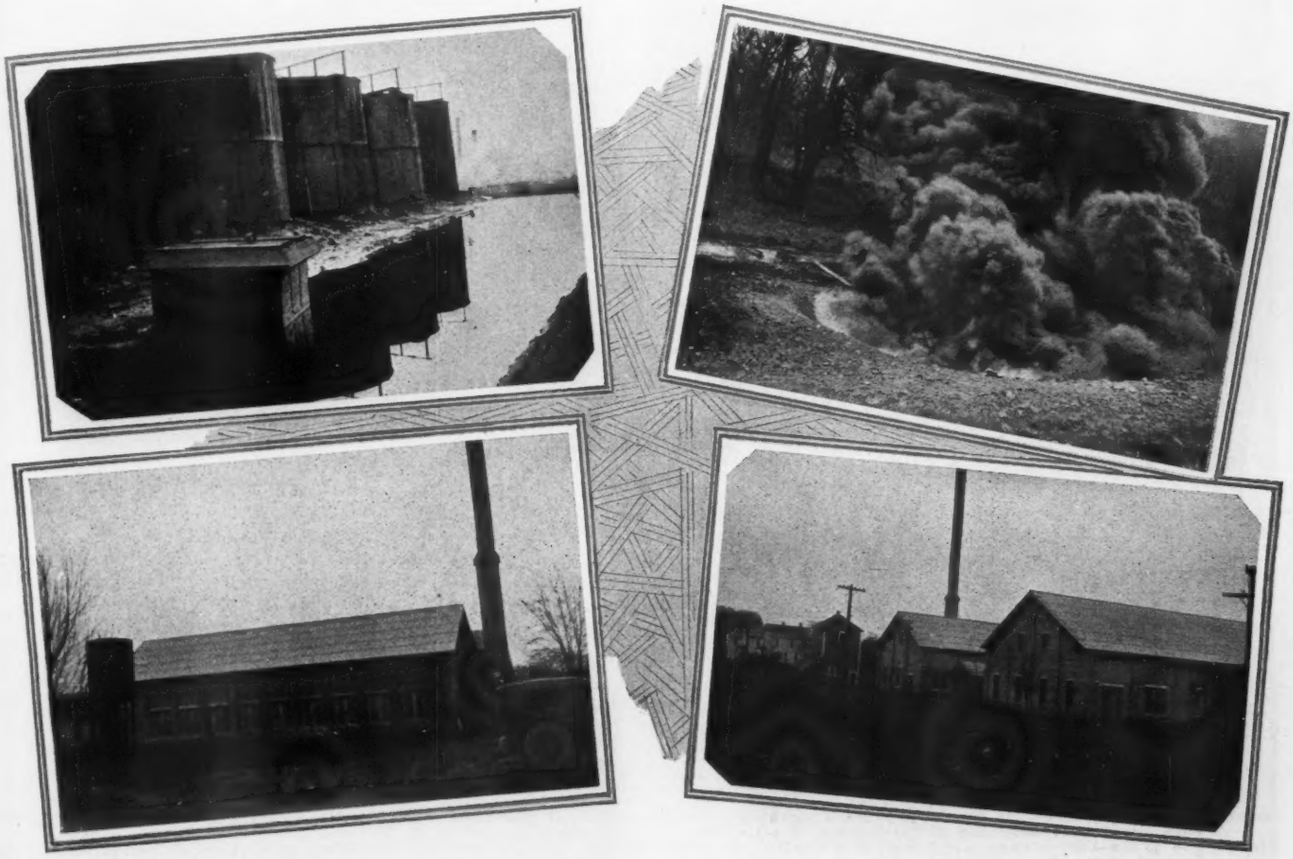
the other pumps farther along the line, operate so as to balance the load. Hence, big tanks of the sort just mentioned are not needed. This means a substantial saving in plant outlay.

A tank capable of holding only 1,000 barrels will suffice to take care of oil arriving at a station during the course of an hour; and a tank of this size is available where centrifugal pumps are installed. Indeed, this provision against an emergency is much in excess of any likely demand, because the stand-by unit is ready to take over the work should the operating pump fail or halt for any reason—only a few seconds being required to start the reserve unit and to open the connecting valves.

pumps are notable because of their flexibility of operation. Not only are the pumps able to work efficiently under a wide range of conditions or demands, but the associate pumps throughout a chain of stations can be brought into service or shut down agreeably to the changing load—thus distributing the burden and the cost of the needful service in accordance with varying requirements. The reciprocating pump does not possess this outstanding adaptability or flexibility of operation. In short, the motor-driven centrifugal pump meets changing conditions in a way that no other pump can, and it makes it possible to do this while effecting substantial savings.

Inasmuch as many oil fields are now served separably associated with a battery of steam boilers and a group of steam-driven reciprocating pumps, such as are commonly required for oil-pipe-line work.

The best evidence of the superiority of the electrically driven centrifugal unit is the action taken by the Illinois Pipe Line Company in the case of its plant at Perrysville, Ohio, where a battery of six boilers and four big reciprocating steam pumps have been supplanted by two motor-driven centrifugal Cameron pumps, each of which is capable of handling 22,000 barrels of oil a day. These pumps and their associate Westinghouse motors occupy only a small fraction of the space needed to house the old steam equipment.



Top, left—A group of sizable tanks that are helping to take care of surplus petroleum during the flush period of an oil field. Right—Burning is the quickest way to get rid of the unmarketable "B. S." Bottom, left—Boiler house of the Illinois Pipe Line Company's pumping plant at Harpster, Ohio. Right—General view of the company's pumping station at Perrysville, Ohio.

By substituting 1,000-barrel tanks for 35,000-barrel tanks the initial outlay is correspondingly less. The driving electric motors, furnished by the Westinghouse Electric & Manufacturing Company, are so arranged that they automatically shut down when the predetermined pressure in the forwarding line drops 25 pounds or when it increases 25 pounds over that prescribed for normal working conditions. In this way, the forwarding station is warned either of a suddenly developed leak in the line ahead or of a tendency to overload the distant receiving pumps.

Enough has been said to make it broadly apparent that electrically driven centrifugal

by power lines, and as electric current is available to most oil-pipe-line pumping stations elsewhere, electricity can be had by the majority of these stations if desired. Purchased power does away with the responsibility of generating power and obviates the first cost and overhead incident to the establishment of an isolated local power plant that calls for unfailing supplies and continual attendance. Purchased power insures continuity of service with the least amount of operating trouble and vexation. Furthermore, electrically driven centrifugal pumps, in themselves, contribute to continuity of service because of their general freedom from the mechanical failures in-

There is still another angle to this subject that should appeal to the pipe-line operator who must look continually forward and be prepared to deal with changing conditions of service. Inasmuch as the opening of an oil field may call for the quick installing of pipe-line pumping stations, or, oppositely, the depletion of a field may necessitate the moving of the pumping plant to some other operating district, the mobility of the essential units is a matter of much economic importance. Electric motors and centrifugal pumps can be mounted and assembled or dismounted and disassembled rapidly; and, because a pump or a motor is of relatively small size and moderate weight, these

machines can be handled readily without special facilities and shipped elsewhere with but little trouble. This cannot be urged in behalf of a steam plant made up of a battery of six 75-hp. boilers and four large, heavy, cross-compound or triple-expansion pumps. All too often the abandoned steam plant entails a heavy loss; and this is apt to be greater when, as is so often the case, the plant is housed in buildings of a permanent nature.

From the foregoing description of the departures recently made by the Illinois Pipe Line Company in its pumping-station equipment, the gains realizable, stated briefly, are as follows:

Flexibility of operation.

Stand-by losses reduced to a very great extent.

Low maintenance cost.

Low unit cost, permitting substantial savings in pipe-line investment.

Ease and rapidity with which units may be installed.

Mobility of units, making it practicable to shift equipment to other fields of service.

Continuity of service due to little likelihood of mechanical breakdowns.

Removal of responsibility of generating power.

The many advantages attributable to the employment of electrically driven centrifugal pumps—viewed from a monetary and a mechanical standpoint—owe their steadily widening recognition to the initiative of the Ingersoll-Rand Company, which has specialized in developing pumps that would be equal to all the demands that might be made upon them in this distinctive and decidedly exacting field of service in the oil industry.

SPECIAL HARBOR TO LESSEN OIL-FIRE HAZARD

UNDER existing harbor regulations at the Port of Goteborg, Sweden, bulk consignments of inflammable oils arriving in tank steamers or in barrels can be unloaded only at special storage stations outside of the harbor limits. The transportation of these oils to the port, itself, is done by barges—tank barges being used for oil in bulk and open barges for oil in barrels. This is all right as far as it goes; but, partly as a result of the restrictions imposed by the fire department, the port facilities are no longer equal to the demands of the steadily increasing traffic. The authorities therefore decided to build a harbor beyond the confines of the city reserved exclusively for the handling as well as the storing of inflammable oils for Goteborg. Work on this project is now underway.

This harbor is to be situated at Marieholm, which is on the south side of the River Gota and about 2½ miles from the center of the main harbor. The plans call for a single basin, to be dredged at right angles to the river, that is to be 246 feet long, 164 feet wide, and 11.5 feet deep. At the entrance to this basin, and parallel to the river, are to be constructed two piers that will have sufficient space between them to permit large tank barges to enter. This opening is to be kept closed by a floating gate or caisson except at such times when vessels want to enter or to leave the sheltered basin. A protecting screen is to be fitted to the caisson to prevent oil from flowing out and polluting the river. Along three sides of the basin are to be unloading quays where oil from tank barges and barrels is to be discharged. Barrels of oil are to be handled at two piers, each 164 feet long, which are to be built along the river bank. The basin has been designed to accommodate five tank barges, each with a capacity of 5,000 gallons of oil.

Left—This new, intermediate pumping station, erected at Galion, Ohio, is equipped with two electrically driven Cameron pumps each capable of handling 22,000 barrels of oil a day.
Right—The 35,000-barrel tank needed at the Coulter Pumping Station when oil was handled there with steam-driven reciprocating pumps. Note the small tank that serves as an emergency reservoir at the Galion station, seen in the picture at the left.
Bottom—Boiler house, pump house, and repair shop at the Coulter Pumping Station. The difference between the buildings at the two stations doing the same work is striking.

The plans of the United States Post Office Department for 1928 call for 10 additional air-mail routes. This brings the total up to 25, aggregating 11,856 miles. The mileage actually covered in the course of 24 hours is, of course, much greater, as many of the routes are traversed by more than one flying machine daily. As a matter of fact, if but one round trip were made every day over each of the 25 courses, the distance flown would be a little less than the distance around the globe at the equator.

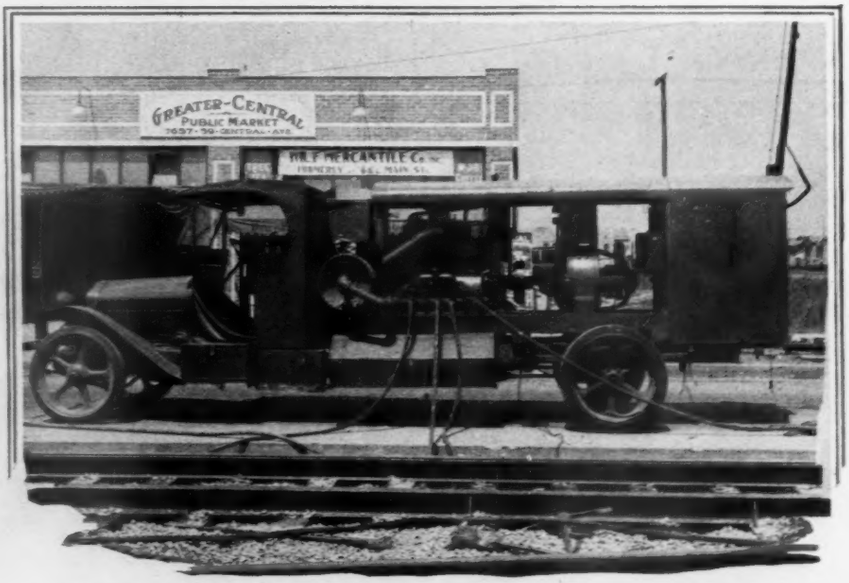
ACTIVE EXHIBITS EFFECTIVE MEANS OF EXPLOITING USES OF COMPRESSED AIR

1—The Governor General, The Right Honorable T. Healy, inspecting a "Jackhamer" at the Royal Society Show, Dublin, Ireland.
2—This tripod-mounted drifter, designed for drilling deep holes, attracted much attention at the Royal Society Show.
3 and 4—These exhibits at the Prague Sample Fair gave a comprehensive idea of the source of compressed air and the tools operated by this motive medium.

Novel Portable Pneumatic Power Plant

By THE STAFF

THE Los Angeles Railway is getting excellent service from a portable compressor that is mounted on a bus chassis. The car had outlived its period of usefulness in the Municipal Bus Department, and was about to be discarded when it was reclaimed by the Way & Structures Department and put to work in a new capacity—that of conveying the compressor and associate pneumatic equipment speedily from point to point along the system wherever the upkeep of the roadbed calls for the use of compressed air.



Broadside of the 9x8-inch electrically driven compressor mounted on a motor-bus chassis. This shows clearly the manifold connections by which air can be supplied through six lines to as many air-driven tools.

The compressor—an Ingersoll-Rand Type Twenty, 9x8-inch unit—has a rated output of 250 cubic feet of free air per minute. It is mounted on a channel sub-frame which is fastened to the main frame. To adequately cushion the machine, additional springs were fitted on top of the regular rear springs; and wheels with solid-rubber tires, such as are on double-deck buses, were provided to take the place of those with pneumatic tires. The clearance offered by the new wheels is a very desirable feature, as the compressor operator can stand within their shelter—protected from passing vehicles—while oiling, changing hose, etc.

A 600-volt motor drives the compressor—the necessary power being taken directly from the overhead trolley. Contact is made by means of a folding arm, of wood, to the upper end of which is secured a piece of bare trolley wire. This wire is connected through jumper cable to the controller of the motor. When in operation, the boom is raised; the upper portion is held in position by a rope; and the bare wire is put in touch with the overhead trolley—the weight of the boom maintaining the contact. When not in use, the arm folds back on itself and rests on a bracket support at the forward end of the bus housing. Thus current is furnished the motor without in any way interfering with street-car traffic.

Because of the size of the chassis, it is possible to carry a larger supply of tools and associate equipment than would normally be the case. Good-sized tool boxes are mounted, one on each side of the bus, to hold the various tie tampers, paving breakers, etc., required by the Way & Structures Department. And to supply these tools with the needful operating air, something like 1,200 feet of air line—which is considerably more than would be used under ordinary circumstances—is wound on a big reel enclosed in a sheet-metal cabinet at the rear of the bus. The shaft of this reel extends through one side of the cabinet and is fitted with a handle to turn the reel. This handle is, of course, demountable.

The air line is made up of numerous sections coupled together. This arrangement makes it possible not only to provide hose lines of differing lengths but as many of them—within the limits of the manifold—as may be required for a given job. Little time is lost in getting the compressor ready for service—the breaking of the couplings and the attaching of the hose to the manifold being but a matter of minutes. As our illustrations show, the air-distributing manifold has six connections. These outlets are spaced on 4-inch centers, and each has its own control valve. The manifold is made of 3-inch steel tubing, and is joined to the air receiver by 2½-inch piping.

This outfit has now been in operation for many months and, according to the engineer of the Way & Structures Department of the Los Angeles Railway, has proved satisfactory in every respect. As a matter of fact, the design of this portable-compressor plant is to be closely followed in constructing other similar equipment.

The Los Angeles Street Railway Company has found this portable-compressor outfit of great service in speeding up repair work with pneumatic tie tampers, paving breakers, etc.

The British Colonial Office has announced the discovery in Sierra Leone, Africa, of a platinum-bearing area 40 square miles in extent. An analysis made by the Imperial Institute, according to *Chemistry & Industry*, reveals that the precious metal from this source compares favorably with platinum from the Urals.

Songhees Graving Dock Near Victoria A Splendid Structure

Ships Touching at the Ports of British Columbia Now Have At Their Disposal a Drydock of Immense Size

By B. D. CLEGG

VANCOUVER grows annually in its industrial and commercial importance because of its sheltered position on the wide waterway that separates Vancouver Island from the mainland of British Columbia. There Nature, in a beneficent mood, created the essentials for a wonderful port for ocean-going shipping bound to and from the Orient by the shortest route across the Pacific. Canadian enterprise has made much of these advantages; and the people of Vancouver are doing yearly more and more to develop the port and to provide facilities commensurate with a steadily growing foreign trade.

Not only do lines of great passenger steamships make Vancouver their eastern terminal in trading with China and Japan, but other seagoing craft are drawn there in large numbers because much of the wheat raised on the prairies of Canada now passes through Vancouver on its way to the Orient or bound to European countries via the Panama Canal. From this rapidly expanding major port of British Columbia are shipped tremendous quantities of lumber, cut in the virginal forests of Canada, as well as many other products that have their origins in Canadian factories, in the fruitful farmlands of the Dominion, or in the waters of British Columbia teeming with seafoods of many varieties. Conversely, Vancouver handles vast volumes of inbound freight destined to Canada, to the United States, and to European centers of consumption.

Because of the extent of her water-borne traffic, Vancouver has called into being port facilities of a fine order, such as piers, warehouses, grain elevators, etc. Drydocks also have been constructed to take care of vessels of all sizes, but some of these drydocks have been built outside of the immediate limits of Vancouver and considerably nearer the sea—notably at Esquimalt. This is understandable, because inbound craft that might be in urgent need of attention would desire to reach a drydock as soon as possible, and Esquimalt is 70 miles closer to the sea than Vancouver. Esquimalt—primarily a naval base—is only three miles away from Victoria and a suburb of that city. It is at Esquimalt that a splendid graving dock has lately been placed at the disposal of Pacific shipping. While this dock is essentially a government undertaking, still it is available to merchant craft. The structure is second in size only to the noted Commonwealth Dock in Boston, Mass. It is big enough to accommodate the largest ship afloat today, and has involved an expenditure totaling substantially $6,000,000. This new maritime convenience is officially known as the Songhees Graving Dock.

The Songhees dock is directly the outcome of the World War, during which the Dominion Government determined that there should be on the Pacific Coast and under the British flag a dock of such size that it could take care of any vessel in existence. After much thought and a careful survey, the neighborhood of Victoria was deemed the most advantageous location for such a project; and Skinner's Cove, adjacent to Esquimalt, was finally chosen—that inlet being peculiarly adaptable for a graving-dock site.

Skinner's Cove was a natural rock basin that required only enlarging to make it ready for conversion into a great dock which, in its finished form, is 1,150 feet long and has a maximum width of 149 feet at the top and 126 feet at the bottom. The clearance at the entrance and at the intermediate sills within the dock is 124 feet in width; and a depth of 49 feet 5 inches assures 40 feet of water over the sills at high tide. The intermediate sills make it possible to subdivide the interior of

© Pacific Airways, Ltd.

An expansive view of a part of Vancouver Harbor and the contiguous city.

© Pacific Airways, Ltd.

Glimpse of a section of the Harbor of Vancouver showing some of the fine piers and types of shipping frequenting that port.

the drydock into two basins by means of an interposed caisson—these separate basins being, respectively, 400 feet and 750 feet in length. Thus, two ships can be accommodated within the dock—that is, a vessel may be docked within that basin best suited to it and which will require the handling of the least amount of water in pumping out the occupied section.

The Songhees dock is lined with concrete—the thickness of the floor slabs ranging between 3 feet and 3 feet 6 inches. These slabs are covered with a finished concrete floor having a uniform thickness of 1 foot. The side walls have an average thickness of 4 feet, but this was increased considerably where overbreak made it necessary to insure contact with the rock surfaces of the excavation. Work was begun on the undertaking in 1921; and the dock was finished and formally announced ready for shipping early in July of last year.

Although favored by natural conditions, still the preparation of the dock site required the excavating of 375,360 cubic yards of solid rock. It was in this fundamental, preliminary work that compressed air and pneumatic rock drills performed outstanding and essential service.

Mr. J. P. Forde, district engineer, Department of Public Works, Canada, has thus described the ledge that had to be removed in clearing the way for the graving dock: "The rock, of volcanic trap, ran approximately parallel with the center line of the dock for nearly its entire length, and had a dip which caused a certain amount of overbreak. This was not excessive, and did not exceed 4 per cent. of the total quantity removed. After the surface rock had been stripped, the underlying material was found to be almost entirely free from faults or fissures, and, as a consequence, leakage through the formation was negligible."

The same authority, in his able paper read before the Engineering Institute of Canada, thus disclosed some of the construction details: "It was necessary to construct a cofferdam around the area to be occupied by the dock; but as there was not sufficient excavated rock available above low-water level for the entire dam it was decided to build it in two sections—each section to enclose approximately one half of the total area, and the rock excavated from the inner area to be used in the outer dam. The inner dam was built of rock dumped from a pile trestle, and was then faced on the outer side with a mat of clay dredged from an adjacent bay in the harbor. It was found that this clay, while very stiff in its original position, became extremely soft when worked and exposed to air and water. Instead of lying on a slope of 3 to 1, as was expected, it flattened out to a slope of 8 to 1; and between high- and low-water levels—where it was subject to constant wave action—the clay was inclined to wash away. To prevent this, it was necessary to construct a bulkhead of round piling supporting tongue-and-groove sheet piling along the entire face of the section. After this was done, no difficulty was experienced in keeping the enclosed area dry.

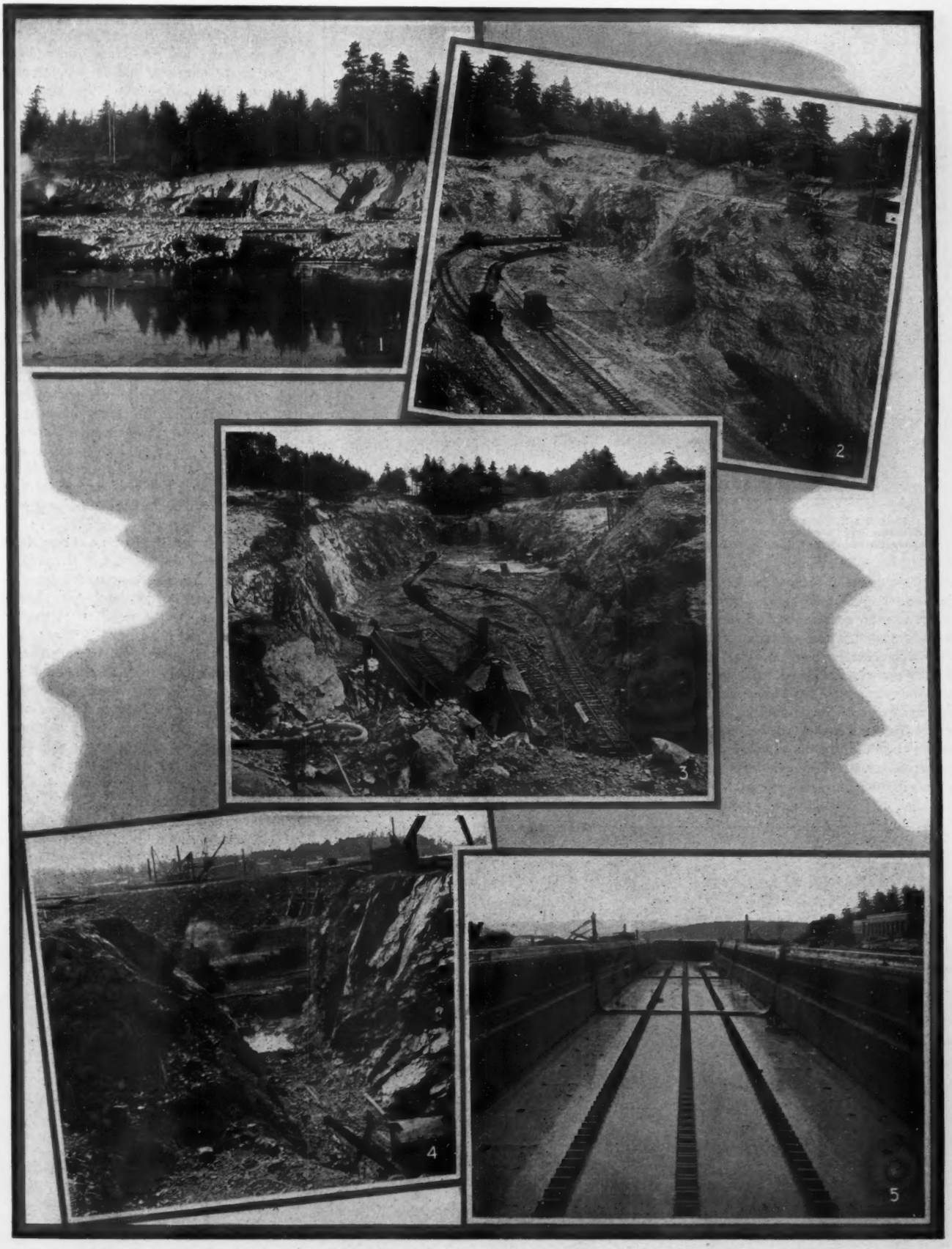
"The outer section of the dam was built in a similar manner with the difference that a core of interlocking steel sheet piling was used to prevent the entrance of water. This was not entirely successful owing, probably, to leaks through the joints of the piling and to the fact that the steel piles did not entirely penetrate the overlying material on the harbor bed. As a consequence, some difficulty was experienced in unwatering this section. Later, a clay mat was laid on the outer face of the cofferdam; and, although the leakage was still large when the enclosed area was first unwatered, it was very considerably lessened after blasting operations began. This was no doubt due to the heavy concussions from the blasting tending to settle and to consolidate the fill."

In excavating the rock for the dock site, Canadian Ingersoll-Rand air-driven rock drills were used. Holes from 18 to 20 feet deep were drilled with DDR-13 "Jackhamers"; and BCR-430 "Jackhamers" were employed for block-hole work. All toe holes were driven with No. 54 piston drills because, at the time, the X-71 had not been developed. All air now required in maintaining the Songhees Graving Dock and for the operation of pneumatic tools used in connection with repairs on vessels in the dock is furnished by a 16-inch PRE-2 compressor, built by the Canadian Ingersoll-Rand Company, Ltd.

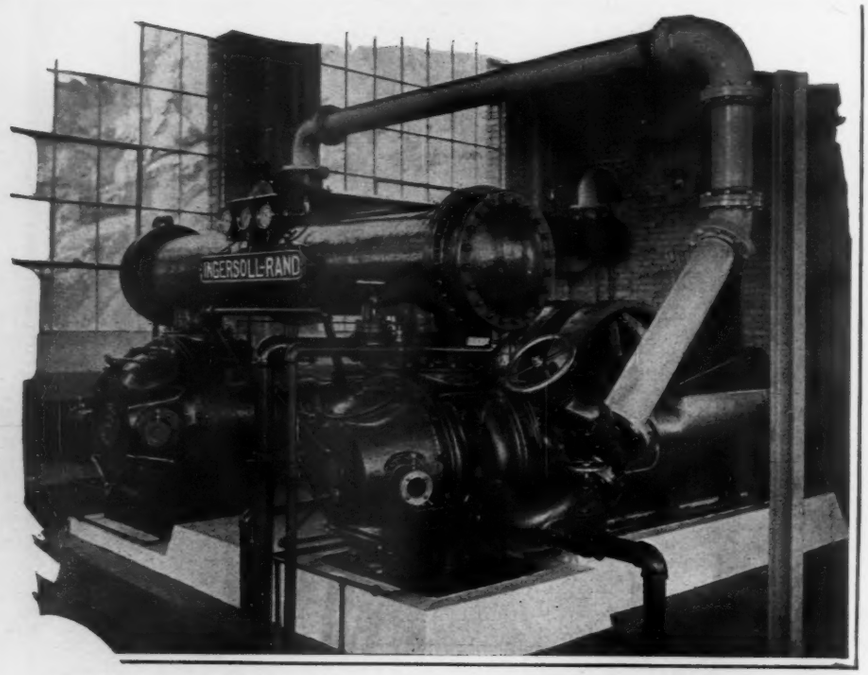
The electric power cables, and the water- and compressed-air mains are housed in a tunnel running around each side and the head of the dock. This makes these lines readily accessible—entrance to the tunnel being had through manholes placed 100 feet apart. The compressed-air line also extends around the foot of the dock wall—the piping being placed in a recess where it is protected from damage by falling tools or timbers. Hose connections can be made with this main every 50 feet.

© Pacific Airways, Ltd.

Vancouver Harbor is one of the finest in the world; and its splendid docks have entailed an outlay of many millions of dollars.



1—Point where rock was excavated for the pump-house and the transformer-house sites. The rock removed was used in building one of the cofferdams.
2—How the undertaking looked at one stage during the excavating of rock at the head of the dock basin.
3—An extended view of the excavation looking toward the head of the basin.
4—The pump pit and the open cut connecting with it. Note the cofferdam at the waterfront end of the project.
5—The finished drydock, with pump house and transformer house at the right.



This PRE-2 compressor, built by the Canadian Ingersoll-Rand Company, Ltd., furnishes air for pneumatic tools employed in ship-repair work and in certain maintenance operations in connection with the dock.

The main pumping plant consists of three 54-inch centrifugal pumps, each driven by a 1,000-hp. synchronous motor. Each pump is capable of handling 60,000 gallons of water a minute. The three pumps can drain the dock, which has a total capacity of 42,000,000 gallons, within four hours. There are two auxiliary pumps, each of which can discharge 9,000 gallons of water per minute. These are used for emptying the drainage tunnels and the suction chamber and also to take care of seepage.

In its lighting facilities and in all other phases of its equipment, this splendid dock is typically up to date and reflects great credit upon those identified with its design, its construction, and its outfitting. The P. Lyall & Sons Construction Company of Montreal and Victoria were the general contractors. The dredging, the excavating, and the concreting was sublet to the Pacific Construction Company of Vancouver. The caissons were built by the Canadian Bridge Company under contract from Yarrows, Ltd., of Esquimalt, who handled the erection and the installation of the pumping machinery in the caissons. Hodgson, King & Marble, of Vancouver, erected the pump house and the transformer house, and put in the electrical and the mechanical equipment. The engineers of the Department of Public Works of Canada designed the dock; and building operations at the dock were supervised by the local departmental engineering staff. Mr. J. P. Forde, district engineer of the Department of Public Works at Victoria, and Mr. K. M. Cameron, chief engineer of the Federal Department of Public Works at Ottawa, were intimately identified with the undertaking.

How Skinner's Cove looked before operations were begun on the excavation for the graving dock.

GREAT FLAWLESS DISK OF OPTICAL GLASS

THE United States Bureau of Standards has recently added another outstanding achievement to its long list of creditable performances. We refer to the making by experts of that bureau of the largest piece of flawless optical glass ever cast in the United States. The great disk is 70 inches in diameter, 11 inches thick, and weighs 3,500 pounds. It was cast in May of last year, and since then—for as much as nine months—underwent gradual cooling.

The batch consisted of 1,000 pounds of special broken glass and 4,600 pounds of sand and chemicals, and was poured into a single pot in a gas-fired furnace. According to the *New York Herald Tribune*, "The molten mass was stirred by hand for six hours and run into a special electrically controlled mold at a temperature of 2,400°F. Throughout the months that followed, the temperature was progressively lowered over periods as slowly as 4½ degrees a day." When the mold was uncovered not long ago in the presence of a distinguished group of scientists, the glass was pronounced to be the most perfect specimen of its weight and size in the world.

The glass has been made for the Perkins Observatory of the Ohio Wesleyan University at Delaware, Ohio, where it will serve as a concave mirror in a new reflecting telescope. Only after no firm could be found in this country willing to cast so large a piece of optical glass did the government bureau contract to do the work, and this it did by a new process developed by a member of its staff.

From Stockholm, Sweden, comes the news that the waste products of the sulphite-pulp plants and the saw mills are being utilized for the production of a fuel for both industrial and domestic uses. The sulphite lye is evaporated, mixed with sawdust and other refuse of woodworking plants, and is then dried. The resulting product, which contains about 60 per cent. of dry sulphite lye and 40 per cent. of dry wood, is pressed into briquettes for domestic consumption or is ground into powder for steam-raising purposes.

Tokyo, Japan, has the distinction of having built the first underground railway in the Far East. The subway, which is said to be earthquake-proof, was opened to traffic late in December of 1927.

Metal Traffic Spots Growing In Favor

By THE STAFF

WITH probably more than 3,000,000 motor trucks and possibly 20,000,000 pleasure cars traversing the thoroughfares of towns and cities or speeding rapidly over highways leading to and from those centers of population, the problem of traffic regulation is becoming increasingly difficult and more and more vital to the well-being of both pedestrians and those carried by the vehicles in question. The situation is further aggravated by the spreading tendency of regulatory officials to insist upon a faster rate of movement on the part of traffic as a whole.

Arrows and other directional marks, indicated with brass "traffic spots," at a puzzling intersection of several streets.

One consequence of this speeding up of vehicular movement, in an effort to lessen congestion, is the greater likelihood of accidents. This is due to the fact that drivers are called upon frequently to make decisions quickly when arriving at critical points in the traffic tide where sharp turns are required. To obviate confusion, to reduce the need of hesitation, various directive agencies of a visible nature have been developed. Some of these have answered well enough in certain surroundings; but for general directive purposes, broad white lines painted on the pavement have been found universally satisfactory. Lines of this sort have been employed more extensively than any other guide marks.

Admirable as such traffic aids are, still they have inherent drawbacks. That is to say, they retain their full visibility for only a comparatively short while when exposed to the weather and to the defacing action of heavy traffic. Furthermore, their refurbishing or renewal must be done either during those hours of darkness when the stream of traffic is at its lowest tide or in the daytime and in the midst of more or less intense traffic—vehicles being temporarily detoured or forced to use a narrowed section of the highway the while. This leads to inconvenience and often to congestion, and is a fruitful source of mishaps of one kind or another.

Traffic experts have given much study to the problem involved; and those authorities are agreed that something more durable than the painted line, something equally visible at all times, is desired. They are also insistent that any substitute shall be essentially simple in principle and susceptible of easy and rapid placing. These specifications or requirements have been met with measurable success by a number of manufacturers that have produced what are known as "traffic spots"—metal disks or squares that can be anchored in the pavement of a roadway so that enough of the metal will project sufficiently above the surface to be exposed to the rubbing and polishing action of passing wheels. This rub is counted upon to keep the metal bright so that it will reflect any light that may fall upon it. Some of these traffic spots are made either of plain steel or stainless steel—which will not rust, while others are fashioned of brass. The yellow light reflected by traffic markers of the latter sort has a notable degree of visibility, particularly under certain atmospheric conditions, so it is said.

Be this as it may, markers of this character are widely utilized, and, therefore, it may reasonably be assumed that they are in all respects satisfactory. Our illustrations show various applications of brass traffic spots made by the Bridgeport Brass Company, of Bridgeport, Conn. These particular markers are, in effect, shallow cups with their rims bent at right angles to the top or rubbing surface. They are manufactured in two diameters: those that are 3 inches in diameter being used to mark pedestrian lines, while those that are 4½ inches in diameter are employed to form traffic divisional lines. The spots are of heavy metal; and are permanent, non-corrosive, highly visible, and easily placed. Once in position, they require no upkeep.

Designs for the layout of traffic markers can be readily made on the pavement with a ruler, a piece of chalk, and a sufficient length of string. Satisfactory results, as far as visibility is concerned, can be obtained by inserting one 3-inch spot in every linear foot. This leaves an interval of 9 inches between the edges of any two adjacent spots. In the case of 4½-inch markers, they can be placed at intervals of 16½ inches between centers, allowing a blank space of 12 inches between adjacent disks. This spacing is recommended for lines; but when words or directional arrows are to be so formed, then the spacing between the spots should be varied according to the degree of visibility sought.

The Bridgeport traffic spots are designed primarily for insertion in roadways finished either with an asphaltic surface or overlaid with wooden blocks. The brass cups can be forced into asphalt

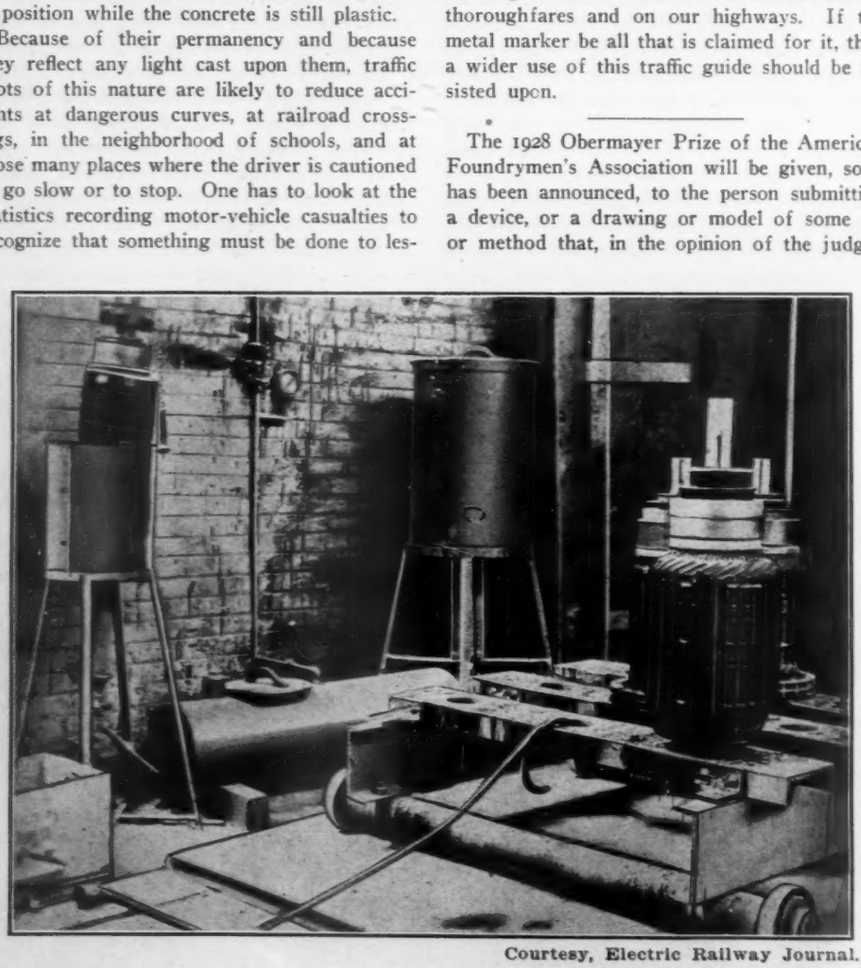
Divisional lines for traffic control in the business section of a bustling city.

"Traffic spots" for the guidance of vehicles at a point where interurban car tracks cross highways leading to populous centers.

or wood by a few blows of an air-operated paving breaker equipped with a suitable driving pad. Of course, the disks can be readily set in a road surfaced with concrete if placed in position while the concrete is still plastic.

Because of their permanency and because they reflect any light cast upon them, traffic spots of this nature are likely to reduce accidents at dangerous curves, at railroad crossings, in the neighborhood of schools, and at those many places where the driver is cautioned to go slow or to stop. One has to look at the statistics recording motor-vehicle casualties to recognize that something must be done to lessen the chance of mishaps of this sort. The welfare of the public is at stake; and the hazards are increased by the continually augmenting number of automotive vehicles in our thoroughfares and on our highways. If the metal marker be all that is claimed for it, then a wider use of this traffic guide should be insisted upon.

The 1928 Obermayer Prize of the American Foundrymen's Association will be given, so it has been announced, to the person submitting a device, or a drawing or model of some jig or method that, in the opinion of the judges, embodies the best ideas for the economical production of castings. The entries are to be displayed at the Philadelphia meeting to be held during the week of May 14. Foundry managers are urged to call this contest to the attention of their shopmen. All participants should promptly notify the Secretary of the American Foundrymen's Association, 140 South Dearborn Street, Chicago, Ill.



Courtesy, Electric Railway Journal.

Compressed air is here utilized to force varnish from a horizontal tank, on the floor, to two vats, standing several feet high, in which armatures are dipped before baking.

NEW PHASE OF ADVERTISING BY AIRPLANE

AN innovation in advertising comes to us from abroad that is said to be both spectacular and effective. It is reported by the United States Trade Commissioner, stationed at Hamburg, Germany, that a large flying machine has been circling over that city for two or three hours after nightfall, when traffic is heaviest, advertising this or that commodity by the aid of electric signs attached to the underside of its wings.

The plane, originally built for the carriage of fourteen passengers, has a combined wing spread of 92 feet. To the wings have been secured specially devised electric signs capable of displaying twenty lines of text that can be seen plainly by the man in the street when the machine is at a maximum height of about 2,000 feet.

The aircraft has three engines that develop 760 hp., and is provided with a gasoline-engine-driven dynamo to generate the current necessary to illuminate the letters, characters, etc. The lighting equipment weighs approximately 1,650 pounds. So satisfactory have been the tests in Hamburg that arrangements have been made for similar sky advertising over Berlin and other large German cities.

HANDLING VARNISH BY AIR PRESSURE

IN the shops of the Dallas Railway & Terminal Company, of Dallas, Tex., a very satisfactory process has been developed for the dipping of armatures prior to baking them. The varnish used in this work, instead of remaining in the dipping vats when not required, is stored in an airtight drum. This drum has a capacity of 25 gallons, and rests in a horizontal position on the floor between two dipping vats. The vats are set up on legs, about 3 feet high, and are connected with the tank by suitable piping.

In operation, the varnish may be forced into either one or both vats simultaneously. For this purpose the regular shop air pressure of 90 pounds is utilized. After an armature has been thoroughly impregnated the pressure is released, and the varnish is permitted to flow back into the drum by gravity.

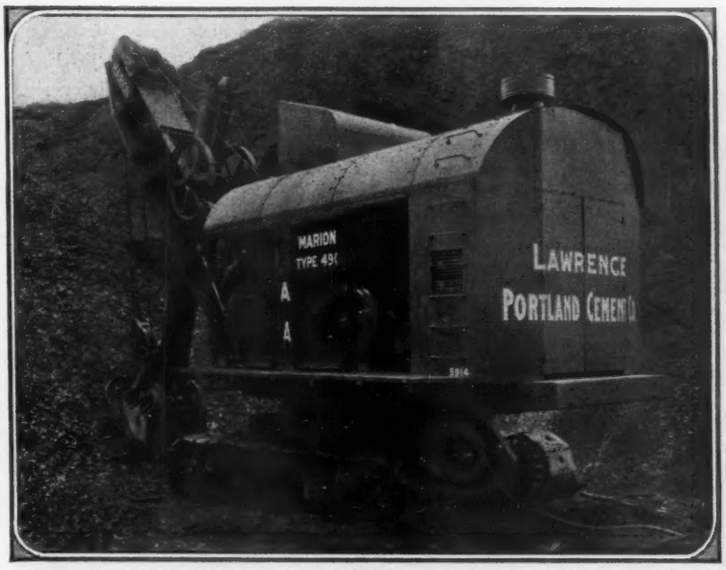
The system, it is said, offers several advantages over open vats. The amount of scum that rises on the varnish is considerably lessened. It offers a positive means of controlling the extent of the dipping—that is, after an armature is lowered into a vat, the height of the fluid can be regulated to suit requirements. It also does away with the need of a collar to protect the lower end of the shaft, which is now simply wiped off with a piece of waste after impregnation.

Power Shovels Are Mechanical Titans

These Excavators Do Work That Would Require Armies of Toilers Equipped With Picks and Shovels

By C. H. VIVIAN

FAITH, an old proverb tells us, will move mountains. Obviously, the reference is to figurative or symbolical mountains, for down through the ages mountains have been regarded as permanent and ineffaceable topographical features, defiant of man's pigmy efforts to dislodge them. And yet, human ingenuity and resourcefulness have served to bring into being contrivances that are today leveling peaks and performing similar acts of cosmic jugglery that were utterly beyond conception a generation ago.



The Marion 490, a rugged, compact model designed for heavy duty.

The invention of explosives of great rupturing force and the development of efficient mechanical rock drills made it possible to shatter large sections of the most resistant earth; and it was only logical that corresponding progress should be made in devising excavating machinery of adequate capacity to handle greater quantities of materials. This evolution has brought us the modern power shovel and its several variations, such as the dragline and the clamshell excavators.

To realize how pronounced and how rapid this advance has been, we have only to consider that the pick and the shovel, which did a large share of the world's digging and loading twenty years ago, are now rarely brought into play except on small or confined jobs. Power shovels are in service today that will take up in one ponderous bite as much dirt as a manual worker can handle in two hours of hard labor. Moreover, they will pick up, with the ease and the dexterity that a man lifts a cube of sugar, rocks of a size that a team of horses could not drag away.

The larger machines of this type made possible the successful completion of the Panama Canal after one failure had been recorded. Through their capability to handle incredibly vast tonnages of material, they are making it profitable to mine low-grade ores and to strip the overburden from coal seams—baring them for economical extraction by a second unit of smaller size. They are lowering the cost of quarrying stone for steel-furnace flux, for concrete, for fertilizer, and for many other purposes. They are helping to build railroads, and to gouge out irrigation canals. The smaller types are familiar to all. In cities they are excavating for buildings, digging subways, and serving to handle material in multifold ways. In rural and mountainous areas they are blazing the trail for new highways, changing the channels of rivers, clearing snow from high-altitude roads, and performing a long list of diversified tasks that would be tediously slow and abnormally expensive by old-time methods.

Left—A standard 8-cubic-yard electric shovel stripping the overburden from a coal vein in Indiana. The cab base is 11 feet off the ground, permitting a dinky engine and train to run beneath it as it swings out over the track. At each corner of the lower frame are hydraulic stabilizers and levelers. The boom is 90 feet long, and the dipper handle has a length of 50 feet. The electrical operating equipment within the cab constitutes a miniature power plant.

Right—A comparison in dipper sizes. The giant scoop has a capacity of 12 cubic yards while the little dipper is of 1 cubic yard capacity. Manganese steel is used for the teeth and front portions of these dippers.

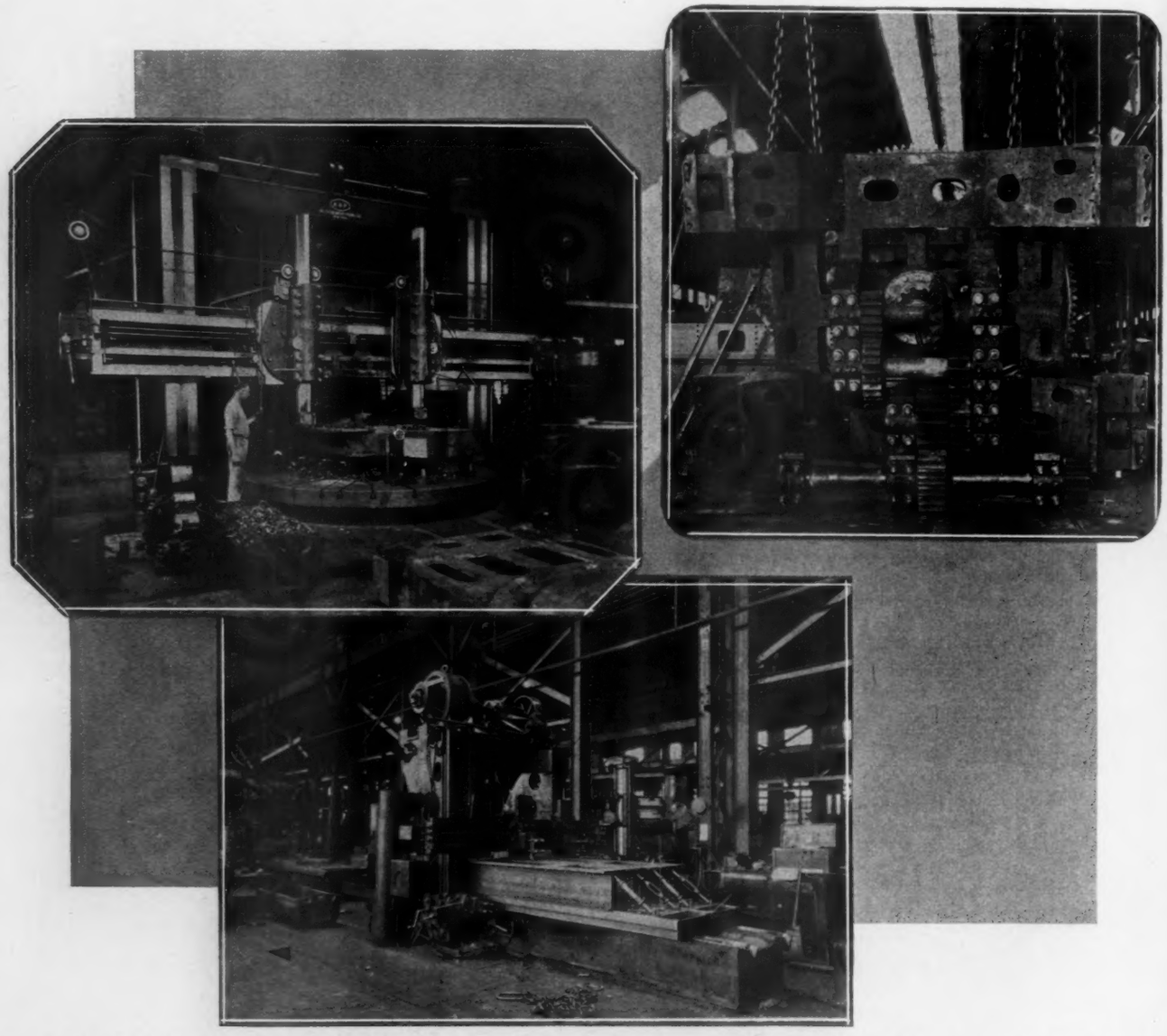
A power shovel at work will still attract a crowd. It is no longer a novelty, but it has an inherent grasp upon the imagination. People are fascinated by the strength that the giant exhibits, by the measured precision with which it is made to act, and by the fine degree of control that the operator exercises over it.

The class known as power shovels embraces steam, electric, gasoline, gasoline-electric, Diesel-electric, and compressed-air machines. The steam shovel was the forerunner of the group, and the other types of drive are essentially developments of the past few years. The tendency at the present time is towards electric shovels. Although introduced as recently as 1910, they now occupy a position of such prominence that more than one-third of the total annual expenditure for shovels is for the electric type. As large machines are more often electrically equipped than small ones, and as a single unit sometimes costs several hundred thousand dollars, the foregoing proportion does not hold as to the number of shovels sold. This preference for electric shovels is explained in the following statement by Mr. D. J. Shelton, director of sales of the Marion Steam Shovel Company, regarding the relative efficiencies of steam and electric drive.

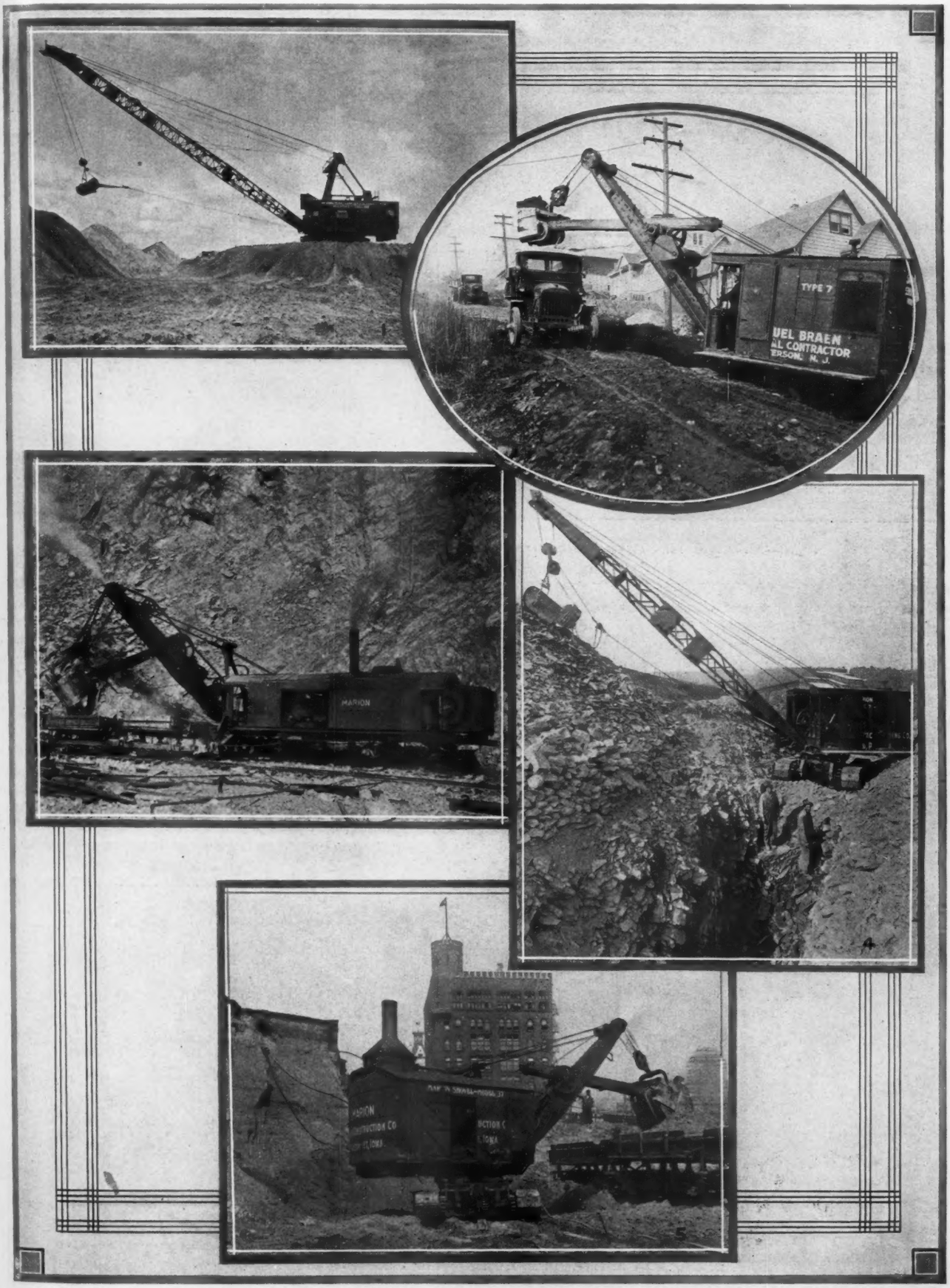
"While the initial cost of an electric shovel is greater than that of a steam shovel," says Mr. Shelton, "the additional expenditure can in most cases be justified. Two pounds of coal will generate and deliver to an electric shovel enough power to handle 1 cubic yard of material. A steam shovel needs 6 pounds of coal to do the same amount of work. The electric shovel ordinarily requires 40 per cent. fewer man-hours per shift than the steam shovel. The percentage of actual operating time should be greater for the electric shovel, especially where fuel and water problems are difficult of solution, and when operations must be carried on in freezing weather."

As all modern shovels are outgrowths of the steam shovel, it is to the latter that we must look for their early history. The first steam shovel was made about 1830, and seems to have been quickly accepted as a vast improvement over existing means of excavating earth. Those early machines were manufactured by the firm of Eastwick & Harrison under patents held by William S. Otis, and were known as Otis excavators. One of the first uses of this type of equipment was in construction work near Springfield, Mass., on what is now a part of the Boston & Albany Railroad.

In its general appearance and fundamental working principles, the Otis excavator did not differ radically from the present-day railroad type of shovel. From an operating standpoint,



Top, right—Underside of the lower frame for a Type 4100 shovel with the propelling gears assembled. This casting weighs approximately 17 tons. Left—This boring mill is one of the largest and most modern available. Bottom—One of the many planers that help to make shovel parts with precision.



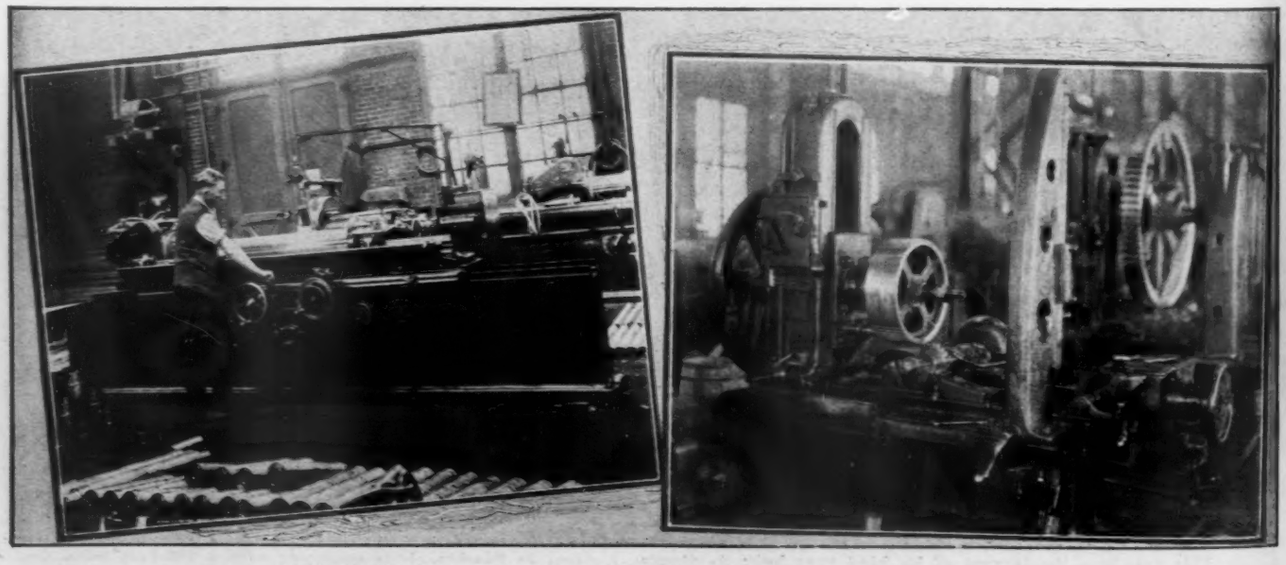
1—This dragline, the largest of its kind ever built, is digging a canal in Florida. It is equipped with a 165-foot boom and a 6-cubic-yard bucket. 2—Small shovels are indispensable on general contracting work. The machine shown here is of 1 cubic yard capacity and has gas-electric drive. 3—A steam shovel of the railroad type engaged in quarry work in Massachusetts. 4—A small gas-electric dragline excavating a trench. 5—A 1¼-cubic-yard steam shovel on a construction job.

Left—Medium-sized castings are hauled in and out of the sand-blast room on a small car.
Right—Air-driven rammer compacting sand in a mold for a large casting.

its greatest defect was a lack of flexibility. It carried one steam engine that maintained a constant speed regardless of the varying loads placed upon it. The several dipper motions were effected by the use of jaw clutches, while the swinging action was secured by suspending the boom from a vertical shaft that served as a pivot. The turning motion was imparted by a cable passing around a wheel mounted on top of the shaft. Obviously, the jaw clutch and the constant-speed engine were poorly adapted to digging in ground that offered frequently varying opposition to the dipper. It is highly desirable to be able to control the speed of the crowding and hoisting operations according to the load imposed, and this the Otis excavator could not do.

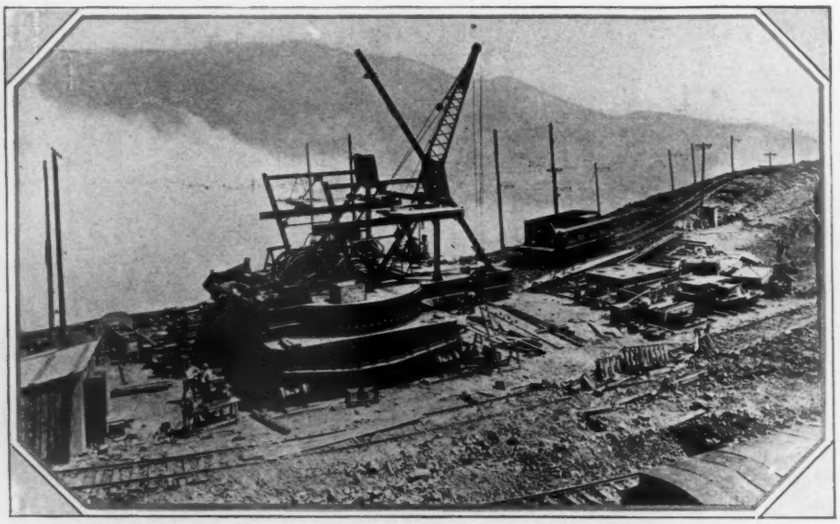
However, the original design survived without material change for nearly half a century, and did creditable work despite its handicaps. In the early "eighties," a shovel operator named H. M. Barnhart conceived the idea of utilizing the slip clutch. He interested Edward Huber of Marion, Ohio; and together they organized a company to manufacture shovels embodying the new and revolutionary principle of applying power. This was the birth of the Marion Steam Shovel Company. The venture did not flourish at the start, but a helping hand was always found among the citizens of Marion when an emergency arose. In this manner several of the merchants of that city obtained stock holdings in a firm that has since grown to be a leader in its field. Today the company occupies the largest plant in the world devoted exclusively to the manufacture of excavating machinery. It is equipped with the most modern machinery and tools available, and employs more than 2,000 men.

The Marion Company makes a complete line of shovels using the different forms of power previously mentioned. One of its outstanding activities is in the development of large-capacity machines. At the time the factory was visited, there was in process of construction an



Left—Shafts are ground with mathematical accuracy on machines of this type.
Right—How the teeth are cut on steel gears.

1—A 9-A riveting hammer driving rivets in the frame of a large shovel.
2—Reaming rivet holes on the deck of a 12-cubic-yard shovel with an I-R air drill.
3—Cleaning a 50,000-pound steel casting for the lower frame of a shovel by means of a core breaker.
4—Ingersoll-Rand air-operated grinders of the type here shown are extensively used for finishing the surfaces of castings.
5—Trimming a steel truck-axle casting with a chipping hammer.



Assembling a Marion Type 350 shovel in the field. This shovel is to be used in mining iron in South America.

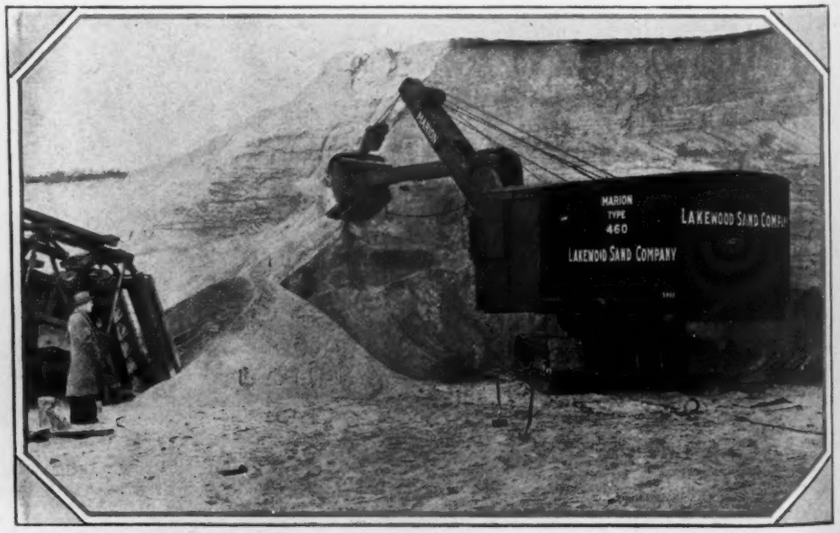
electric shovel designed to carry a 12-cubic-yard dipper, and work was being started on one to have a 15-cubic-yard dipper. This latter unit will have almost twice the capacity of the largest power shovel now in service. One dump from its dipper would completely fill a room 5x9x9 feet, or about the size of a bathroom in the average home. It is conservatively estimated that this 15-cubic-yard shovel will handle a mass of earth that would require a brigade of 3,000 hand shovelers. It will be used to uncover coal deposits that lie 60 feet below the ground surface. It would seem that there is an economic limit to the size of shovels, but engineers of the Marion Company say it has not yet been reached, and predict that even bigger machines will be needed. The two units just mentioned are special orders; but a standard machine is made that scoops up 8 cubic yards of material every time the dipper digs in. Shovels of this size are at work in Indiana and Illinois stripping 40 feet of overlying earth from coal veins; they are loading ore in Minnesota and in Chile; handling limestone in Michigan; and doing other large-scale excavating and loading jobs in various parts of the world. In the year 1926 such a machine moved 1,800,000 cubic yard of overburden from a seam of coal in Indiana, exposing 360,000 tons of coal. The 8-cubic-yard shovel is of gigantic proportions. An idea of its size may be had when it is understood that seventeen railroad cars are required to ship the more than 800,000 pounds of parts that go to assemble it.

Shovels are divided into two broad classes: the railroad type and the revolving type. In the railroad type, so named because it was first used predominantly on railroad work and was mounted on railroad trucks, only the boom and the dipper revolve—the cab and the superstructure remaining stationary. This shovel is built in capacities up to 6 cubic yards. About 1910 the full-revolving type was introduced; and this machine is today used on most operations. It is distinctive in that the entire mechanism above the lower frame may be made to revolve through a complete circle—that is, it is able to take up material and turn around to deposit it. In the case of the 8-cubic-yard shovel, referred to previously, the spoils may be dumped approximately 200 feet from the point where they were obtained. At this range, it has an operating speed of a cycle every 50 seconds.

While the slip clutch applied by Mr. Barnhart to shovel design gave some flexibility and a semblance of speed control to the various motions, it was not thoroughly practicable because of the delicate adjustments that were required. Engineers solved the difficulty by providing a separate engine for each of the three motions involved, namely, hoisting, crowding the dipper into the material, and swinging. In the first electric shovels the makers returned to the principle of clutch or friction drive, but this was soon discarded for independent motors. Today only the direct-gasoline-engine-powered machine has clutches, but these clutches are of a greatly improved type and are thoroughly serviceable. Shovel makers have held divergent views as to the advisability of using alternating or direct current for electric motors. The Marion Company has contended from the start that direct current is best adapted; and all its machines are equipped with motor-generator sets to convert alternating current into direct current in the field. Another change that has manifested itself in recent years is the predominance of crawler traction. The larger units have one and sometimes two crawler belts under each corner. Even the railroad type of shovel is now frequently mounted on crawlers.

It must be apparent to anyone who has watched a power shovel in operation that it is subject to tremendous strains, stresses, and jars. These are so great, in fact, that they can in some cases hardly be computed. Often the dipper is crowded into a bank apparently composed of uniformly yielding material that offers little resistance. Then, suddenly, a hidden obstruction is encountered that stops the progress of the dipper—the resulting shock racking the entire machine. Considering, in addition to this fact, the hundreds of times the shovel performs its function in the course of a day, and that it is continually exposed to dust and dirt, it can be appreciated that the wear and tear is extremely severe. The only safe course the manufacturer can pursue is to use the very best materials available, to make the assembly of the machine simple, and to build it of as few parts as possible.

Following such a policy, the Marion Company utilizes steel of the toughest and most durable character for all parts that are subjected to great punishment. A special alloy has been produced for general castings, while manganese steel is employed for driving gears, gear racks on dipper handles, teeth and fronts of dippers, and for other parts that undergo rigorous service. To reduce the number of parts, and thus to minimize the effect of stresses, single large castings have in numerous instances taken the place of built-up sections. The most pronounced example of this is in the case of the lower frame, which is virtually the foundation that must carry all the



An electrically driven shovel eating into a mountain of sand.

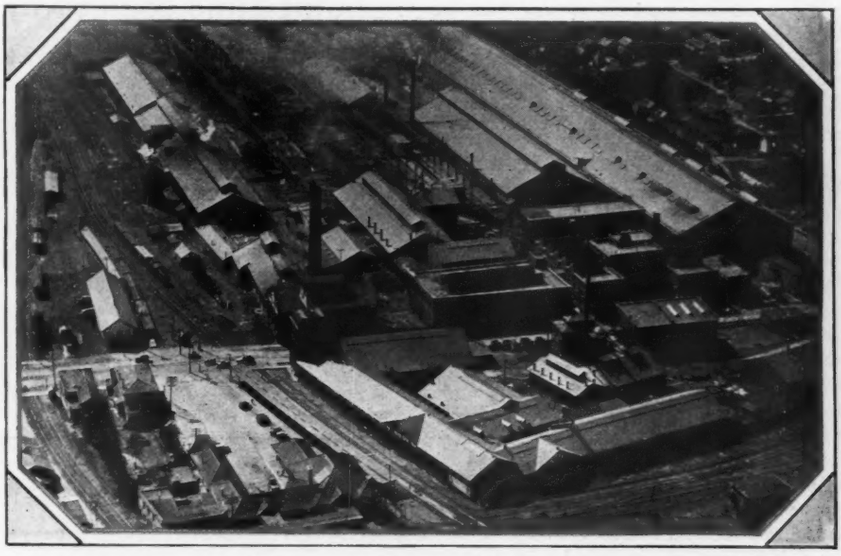
weight and absorb the burden of the shocks. For shovels of all sizes this lower frame is cast in one piece whenever it is possible to keep it within permissible shipping weights and dimensions. This results in some extremely large castings which call for exacting foundry and machine-shop practices.

Pneumatic tools play a very important part in the foundries, not only in preparing the molds to receive the charges of metal but also in suitably cleaning the castings after they have been formed. Several hundred tools of various types are in service. In fact, substantially all the air delivered by the compressor plant—2,500 cubic feet per minute—goes to operate these appliances. Ingersoll-Rand tools have been standard equipment for many years.

The steel foundry is provided with a 25-ton open-hearth furnace as well as with an electric furnace. Ladles of molten metal are transported to working points by overhead electric cranes, which are in general use throughout the plant. Some of the castings are of such sizes that the flasks are sunk below the floor level to give them the additional support of earthen side walls.

An electrically operated "sand slinger" runs on an 8-foot track along one side of the foundry. This machine carries suitable appliances for riddling the molding sand as it travels back and forth. It also has a magnetic separator to extract nails and miscellaneous iron. The sand slinger has a capacity of 10 tons of sand, and this it discharges by centrifugal action into the flasks—the sand being directed as desired by moving the spout through which it is emitted. The sand is ejected with sufficient force to pack it securely in place. However, for much of the work done in the foundry this mechanism is not suitable, and the hand-held sand rammer is employed instead to tamp the sand firmly around the patterns. In the iron foundry, where the average run of castings is much smaller, these pneumatic rammers are used exclusively.

After a casting has cooled sufficiently to permit handling, it is taken by crane to the end of the room where it is rough cleaned and the cores are removed by means of air-operated core breakers. Some of the castings weigh more than 50,000 pounds as they come from the flasks, and they constitute cleaning and core-removing jobs of considerable magnitude. After this preliminary treatment, the castings are hauled on flat cars to the regular cleaning department in an adjoining building. There they are sand blasted. The large pieces are cleaned on the floor in the open; medium-sized ones are drawn on small flat cars into a sand-blast room; and small ones are sand blasted in a room into which they are fed on a Sly turntable. Tumbling barrels also are utilized for some of this work.



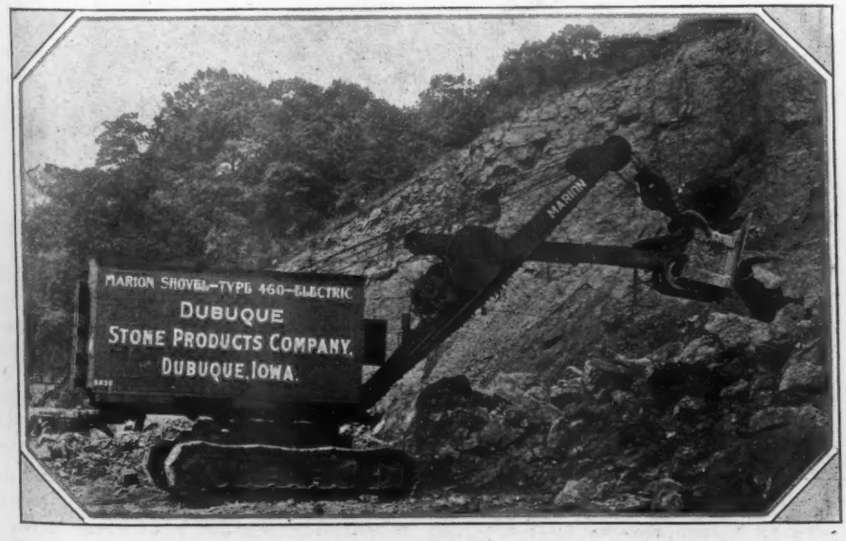
Airplane view of the plant of the Marion Steam Shovel Company at Marion, Ohio.

The castings are next moved by cranes to suitable points for grinding and chipping. Big electric grinders of the swing type are employed on large, flat surfaces. Irregular areas on large pieces and all small pieces are treated by means of air-operated grinders. Pneumatic chippers serve to remove gates, sprues, and miscellaneous adhering bits of metal and metal fused with sand.

The machine shops are extensive and ultra-modern. A variety of milling, boring, and planing machines of conventional types are installed, while much of the shop equipment is of a sort that can be duplicated in but few plants. For example, there is a planer that will accommodate a 12x12-foot casting. Because it is constituted to do rugged, grueling work, the power shovel is commonly thought of as a roughly built machine. But inspection of the machine shop and the methods in force there quickly dispels such a conception. Gears are ground to mathematical accuracy; shafts are similarly treated; and every effort is made to insure precision of all parts.

One end of the machine shop serves as an assembly floor where the shovels are set up. Those that can be shipped without dismantling are left complete. The larger types, which are shipped in knocked-down form, are taken apart after it has been determined that every detail is as it should be for quick and proper assembly in the field. The frames for the bigger machines are built of structural steel—girders up to 72 inches in size being employed. Booms, decks, and other parts are also of fabricated construction. Their assembly calls for the driving of hundreds of rivets, and for this work air-operated rivet hammers are utilized. Another use of air in the plant is for the spray painting of cabs and other portions of the finished shovels.

Besides the manifold services performed by compressed air in the factory, it is also essential in the field in the assembly of the large machines. Many of the sections are there put together permanently by riveting. Usually, the air for this purpose is supplied by portable compressors. When these are not available at points to which shipments are made, the company furnishes them as a part of the erecting equipment. Special derricks have to be provided to unload and to set up these huge shovels. The task is one of such proportions



The development of the power shovel has made it possible to handle economically vast amounts of rock in the quarry.

that the company specifies 30 days as the normal time required to assemble a unit of 8-cubic-yard dipper capacity.

The service of compressed air extends from the manufacturing phase through to the operating end. All electric shovels are equipped with a compressor of the street-car type. This supplies air to manipulate a clutch that disengages the hoist drum from the motors and also to work lock brakes for the various driving motors. These brakes hold the load after the power has been shut off. They are set by springs and released by air; and their action is made automatic by means of a magnetically operated air valve regulated from the master controller.

Small shovels up to 1½ cubic yards capacity are frequently operated by compressed air. Their principal field of usefulness is in tunnels, subways, and similar excavations where the atmosphere should not be vitiated. Sometimes steam shovels are temporarily converted to air drive; but shovels are produced that are especially designed to use air. They are essentially steam machines in which air receivers take the place of boilers. Steam is ordinarily employed at 125 pounds pressure, while air is commonly available at only 100 pounds pressure. To allow for this difference, the hoist of the air machine is fitted with a 4-part instead of the 3-part hitch that is standard on the steam shovel, and uses a higher ratio on the propelling gears.

It is claimed that the potash deposits discovered not long ago in the Solikamsk district of the Ural Mountains contain more than 1,500,000,000 tons of potassium oxide. The mineral lies at a depth of about 600 feet.

ENGINEERING SOCIETY HAS ANNUAL DINNER

THE Engineers Society of Northeastern Pennsylvania held its thirty-first annual banquet at the Hotel Sterling, Wilkes-Barre, Pa., on January 24. The dinner was a great success—more than 500 members and guests being present. These dinners have long been something besides pleasurable yearly events; and the speakers generally have had much to say that was well worth while. The recent affair was not an exception in this respect.

The retiring president, Mr. R. H. Buchanan, made a short address in which he reviewed the activities of the society during 1927 and thanked his associates for their splendid coöperation throughout the twelvemonth of his term of office. In closing, Mr. Buchanan paid this graceful tribute to his successor, Mr. C. H. Dorrance, who will fill the presidential chair during 1928: "If any void has been created by my withdrawal from the presidency, it will be filled to overflowing by him whose gallant, gentlemanly bearing, whose steady adherence to principle, and whose rare and accomplished powers in organization and leadership are already known to everyone."

The other speakers of the evening were Mr. John B. Kennedy, associate editor Collier's Weekly; Mr. L. A. Hawkins, executive engineer, Research Laboratory, General Electric Company; and Mr. John M. Carmody, editor, Coal Age. Both Mr. Kennedy and Mr. Hawkins made very interesting speeches; but Mr. Carmody's subject, the *Troubles of Old King Cole*, made the hit of the evening because his words touched the lives of most of his audience—men who are directly or indirectly affected by the ups and downs of the anthracite industry. Mr. Carmody made a number of constructive suggestions; and his desire to point possible ways by which the authracite industry might come again into more prosperous days was heartily appreciated and applauded. He declared that a survey should be made of the sales possibilities of anthracite; and that the public should be educated in the burning of hard coal with the same degree of thoroughness that they are taught to operate the motor cars they buy.

R. H. BUCHANAN

Mr. Dorrance made a brief address in which he outlined some of the prospects of the future. He called attention to the serious side of engineering, and emphasized the need of meeting competition in the anthracite field by more effective employment of engineering skill wherever that could be done. We regret that no picture of Mr. Dorrance was available for reproduction in this issue.

An air-operated utility hoist is here shown scraping coal in a coal pocket. The loaded scraper is pulled by a cable wound on the drum of the hoist. The unloaded scraper is returned to the loading position by a rope running from the scraper to a pulley and thence back to the utility hoist, where it is wound around the auxiliary winch head.

TUNED RADIO USED FOR RAPID WEIGHING

ONE of the latest applications of the radio principle, we learn from a recent issue of the *Journal of the American Institute of Electrical Engineers*, appears in a weighing machine developed by the laboratory staff of a large New England producer of pulp and paper. This unique device automatically weighs any material—such as paper, rubber, chewing gum, and coated fabrics—passing through the mechanism in continuous web form. This is accomplished at full machine speed without touching the web at any point.

The principles underlying this unusual development are those of the tuned radio circuit. The material passes between two parallel metal plates which act as a condenser in the receiving circuit. Variations in the weight of the web change the capacity of the condenser and affect the response of the circuit to a wave of controlled frequency. These variations are shown on a meter connected in the circuit and may be used to operate machine controls by suitable relays. The machine is of great service in maintaining uniformity in weighing paper.

Report Shows Marked Economies of Oil-Electric Drive For Tug

Comparison Between a Steam Tug and an Oil-Electric Tug In the Service of the Long Island Railroad

THE object of this comparison was to show the saving that could be obtained by the Diesel tug over the steam tug. It also explains the advantage of the electric-driven tug with pilot-house control over direct steam drive with engine-room control.

The steam tug *Patchogue* was selected for comparison as it is considered the best steam tug in the Long Island Railroad fleet. It is also comparable as to engine rating and size of hull. It is propelled by a compound condensing engine. Steam is generated by two Almy water-tube boilers equipped with oil burners.

The *Meitowax* is the first Diesel-electric tug built for the Long Island Railroad, and is being watched very closely for development. The prime movers of this boat consist of two 4-cycle Ingersoll-Rand oil engines, each engine having six cylinders, 13 inches in diameter with a 19-inch stroke, rotating continuously in one direction at 265 revolutions per minute and rated at 340 b.hp. Each engine is direct connected to a Westinghouse direct-current, shunt-wound generator rated at 230 kw., 250 volts, 920 amperes, and has attached to it a 25-kw. compound-wound exciter.

Close-up of the oil-electric tugboat "Meitowax" of the Long Island Railroad fleet.

The generators serve to furnish current for the double propelling motor, direct connected to the propeller shaft, which is designed for a continuous rating of 560 hp., 500 volts, and 920 amperes, and to operate at 115 to 130 revolutions per minute. It is of the open, shunt-wound, double-armature type, and is arranged for separate excitation at 125 volts. It consists of two separate field structures and two armatures mounted on a common shaft supported in two pedestal bearings.

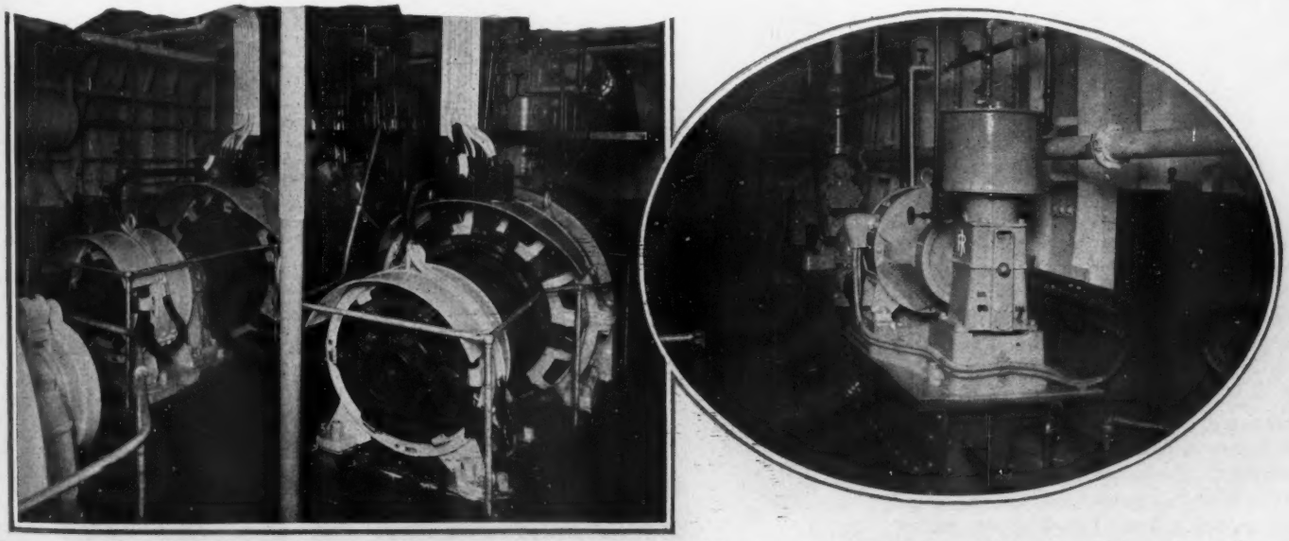
It will be noted from the following statement of costs that a considerable fuel saving is obtained in favor of the oil-electric tug. There is also a saving of time in fueling in favor of the oil-electric tug, which is not mentioned in the comparison of costs. The steam tug requires about four hours per week for fueling, while the oil-electric requires one hour in three weeks. One other advantage is that it is not necessary to store oil on the dock at Long Island City for the Diesel tug, due to the fact that fueling is required about once in three weeks and the boat can go to the oil company's dock. The steam tug is fueled every other day, which makes it necessary to have oil on hand at the terminal.

The total annual saving, based on the table of comparative costs, would in six years be sufficient to purchase a new boat.

Performance.

The accompanying curve sheet shows the comparative shaft horsepower, revolutions per minute of the propeller, and speed of tows obtained from data collected on a series of tests made with the steam tug *Patchogue* and the Diesel-electric tug *Meitowax*. It will be noted from the shaft-horsepower curve that, in starting a tow, the electric tug *Meitowax* delivers greater horsepower than does the steam tug *Patchogue*, which results in a quicker acceleration curve.

The steam engine is capable of delivering a



Left—The two 340-hp. Ingersoll-Rand marine engines of the tugboat "Meitowax." These engines drive Westinghouse generators and exciters.
Right—Type Fifteen, 2-stage air compressor on the tugboat "Meitowax." This compressor furnishes starting air for the oil engines.

Pilot house and control station on the tugboat "Meitowax."

maximum torque corresponding to full steam pressure and maximum cut-off. The possible power is proportional to the revolutions per minute of the steam engine, which will vary by adding or decreasing the tow-line pull. When accelerating, the tow-line resistance increases and, in turn, will demand increased torque and power. Due to the fact that the engine is working at maximum torque, the revolutions per minute will decrease until the torque demand is equal to the maximum steam-engine torque. This decrease in revolutions per minute is responsible for the decrease in the power of the steam engine.

The Diesel electric differs from the steam tug in power application to the propeller shaft. The engines run at a constant speed, controlled by a governor, and are connected to the propeller shaft through the generator and the motors. This arrangement provides for constant voltage, and the horsepower varies according to the demand of the propeller. During the acceleration of the tow, the horsepower of the Diesel engine, with electric drive, increases as the torque demand of the propeller shaft increases. It can be seen from the curve sheet that the speed of the propeller is constant for the *Meitowax*, except for a short period at the start and as the speed of the tow increases—the shaft horsepower varying inversely to the shaft-horsepower curve of the steam engine. With this condition, the maximum power is at all times available with electric drive, which is desirable when switching floats.

Experience with the Diesel-electric tug *Meitowax* in service has shown several advantages in operation. One of these is the pilot-house control. With this control the boat can be advanced toward a float or dock at any desired speed and can be quickly reversed from full speed ahead to full speed astern. This prevents damages to floating equipment. It is also advantageous in taking gradual strain on tow lines. The Long Island Railroad Company has found that the *Meitowax* uses about 50 per cent. fewer lines than any one of its steam-driven tugs.

Observation on the steam tug *Patchogue* showed that 52 bells were transferred in 20 minutes from the captain to the engineer when switching a float from the dock into the float bridge. A failure or a misunderstanding of bell signals would sometimes result in collision.

Conclusion.

The economy in operation of the Diesel-electric tug over the steam tug, as shown in this report, lies in the lower fuel cost and the reduced crew, and amounts to $34,589.40 per year. Further, as has been brought out, the Diesel-electric tug is handled much easier and quicker than the steam tug.

For Long Island Railroad service, tugs with Diesel-electric power are desirable, as this system provides for quick handling when switching. All Long Island Railroad tugs do an equal amount of switching and towing. For the foregoing reasons, and because of their operating economy, any new tugs are to be equipped with Diesel-electric drive. The first cost is greater than for a steam tug; but, as this comparison has made plain, this is recovered in a short period through the savings effected.

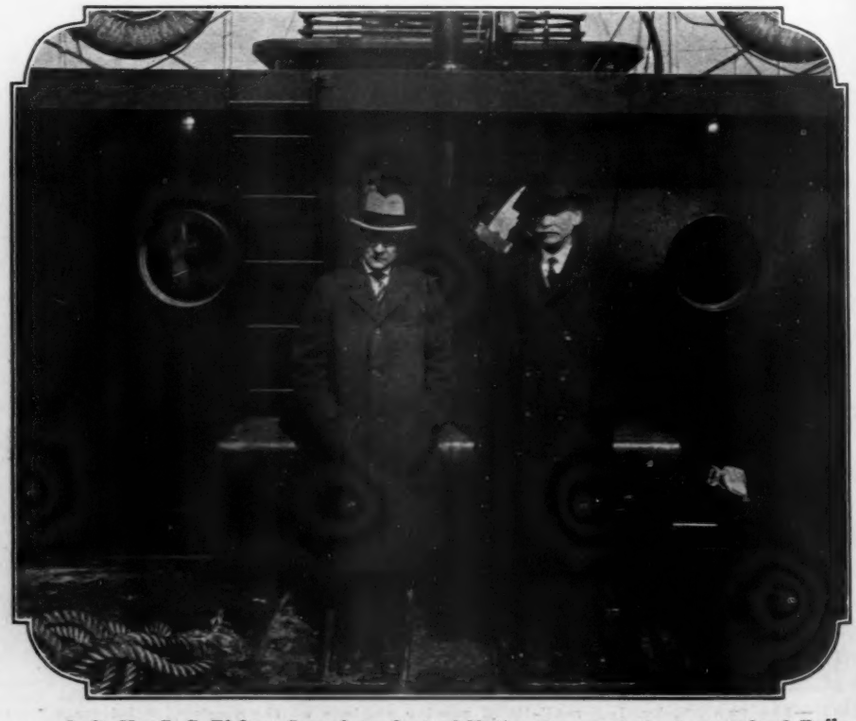
Principal Features of the Two Boats

Patchogue

Material	Steel with guards
Length	100.5 ft.
Beam	24.5 "
Draft	11.5 "
Engines	Compound condensing
Diameter of cylinder	18–38 in.
Stroke	28 "
Propeller	
Material	Cast steel
Diameter	9 ft.
Pitch	11 ft. 6 in.

Meitowax

Material	Steel without guards
Length	108 ft.
Beam	26 "
Draft	13 "

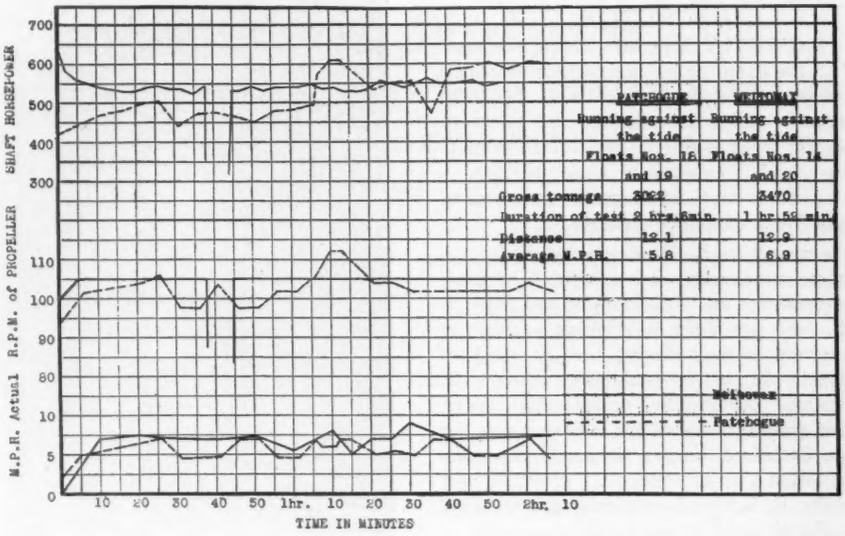


Left, Mr. G. C. Bishop, Superintendent of Motive Power of the Long Island Railroad. Right, Mr. W. J. Davidson, President, Staten Island Shipbuilding Corporation.

Engines.....Two 6-cylinder, 4-cycle Diesel
Diameter of cylinder..... 13 in.
Stroke ..... 19 "
Propeller
Material .....Cast iron
Diameter ..... 9 ft.
Pitch ..... 11 ft. 6 in.

The following comparison is based on the two aforesaid tugs working three 8-hour shifts per day. The figures are based on observed data obtained during the operation of these boats in regular service covering a period of four days. Each boat hauled two car floats from Long Island City to Greenville, N. J., and from Greenville, N. J., to Long Island City in each 8-hour period, and also switched floats in and out of the float bridges at Long Island City to fill in the 8-hour day.

Fuel Consumed	*Patchogue*	*Meitowax*
Low-grade oil	9,256 gals.	
Diesel oil		1,920 gals.
Time	4 days	4 days
Fuel consumed per 24-hour day	2,314 gals.	480 gals.



COST OF OPERATING PER 24-HOUR DAY

	Patchogue		*Meitowax*	
A—Cost of fuel per day.....	2,314 gals. @ 4½c	$104.13	480 gals. @ 5c	$24.00
B—Lubricating oil, supplies:				
Water		1.00		
Grease	1.5 lbs. @ 14c	.21		
Cylinder oil	.3 gals. @ 26c	.08		
Engine oil	.72 gals. @ 36c	.26		
Lubricating oil			2 gals. @ 60c	1.20
Total cost of fuel and lubricating oil		$105.68		$25.20
C—Crew's wages		$108.26		$93.98*

SAVING PER 24-HOUR DAY

	Patchogue	*Meitowax*	*Saving*
A—Total cost of fuel and lubricating oil.....	$105.68	$25.20	$80.48
B—Crew's wages	108.26	93.98	14.28
Total	$213.94	$119.18	$94.76

SAVING PER 365-DAY YEAR

A—Total cost of fuel and lubricating oil.....	$38,575.20	$9,198.00	$29,377.20
B—Crew's wages	39,514.90	34,302.70	5,212.20
Total	$78,090.10	$43,500.70	$34,589.40

**The difference in the wages results from the elimination of the three firemen on the Diesel-electric tug.*

Note: This report is published through the courtesy of Mr. G. C. Bishop, Superintendent of Motive Power, Long Island Railroad.

ANOTHER WAY OF MAKING AERATED CONCRETE

AERATED concrete apparently can be produced in a variety of ways, the latest of which makes use of ice instead of gas or compressed air to bring about the desired porosity. This so-called ice-concrete was conceived in Finland.

Like ordinary concrete, it consists of cement and sand; but, in place of water, snow or broken ice is added to the mix. As the ice melts, the heat of the mass evaporates the contained water and forms, so it is claimed, a uniformly cellular structure of extremely light weight. In fact the saving in weight, as compared with ordinary concrete, is said to amount to from 20 to 50 per cent. The porosity of the material varies directly with the quantity of ice put in the mix.

While this process might be adaptable for countries like Finland, where ice of Nature's making is available the greater part of the year round, less favored places will have to depend on gas or compressed air in the manufacture of building material of this sort.

AUTOMATIC RENEWAL OF HEADLIGHT BULBS

HEADLIGHTS on locomotives perform an important function, and they have been known to hold up trains when the 250-watt bulbs suddenly burned out. To prevent such delays, an electrical inspector in the employ of the New York Central Lines has devised a mechanism that automatically supplies a second lamp the moment the first one ceases to function.

This safety device consists of a frame that fits into the front part of the case. In this frame two lamps are so mounted that the extra bulb falls into position the instant the service lamp burns out. This is effected, according to the *New York Central Lines Magazine*, by means of two relays, the windings of one of which are in series with the filament of the main bulb. When the filament burns out this relay drops its armature on a back contact, with the result that current flows through the windings of the second relay and through the filament of the auxiliary lamp. This action causes the 32-volt headlight circuit to be short-circuited through a fuse which controls a locking arrangement by means of which the main lamp is released from its position and the auxiliary lamp is dropped into its place.

The value of such an arrangement is obvious; and while the safety device was primarily conceived for use on locomotive headlights, it might serve to even greater advantage in the case of signal lights, flood lights, and kindred installations that may be unattended or so placed where it would not always be convenient promptly to renew a burned-out bulb.

There have latterly been introduced in German collieries hoisting buckets and baskets of duralumin instead of steel. The carriers made of this metal are said to weigh only about one-third that of the steel ones, and, therefore, effect a considerable saving in power, wire rope, etc. As many German coal mines are fairly deep, buckets of the material—which is acid-resisting—are finding favor.

NEW FORM OF FIRE-DAMP DETECTOR

A RECENTLY invented electrical detector of fire damp or methane—the combustible gas which is responsible for most coal-mine explosions—has been called one of the most important forward safety steps in the twentieth century, and is expected by mine operators to put an end to much of the tremendous loss of human life in coal-mine disasters.

The apparatus has been developed through coöperative research work instigated by coal-mine operators and legislators of the State of Utah, who are doing everything possible to put an end to the suffering such as has been caused in the past by coal-mine explosions in that state. Among the organizations which offered their services to this endeavor was the Union Carbide & Carbon Corporation. At its Long Island City laboratories, a group of men —led by E. K. Judd—worked for two years with the thought in mind that, inasmuch as fire-damp explosions are directly due to combustible gas, an automatic, accurate, and rugged detector of combustible gas would be the most practical aid in helping to avoid such catastrophes.

The basis of the automatic methane detector is a platinum coil, about an inch long and five-thousandths of an inch in diameter. When such a filament is heated to a constant temperature it becomes slightly hotter in the presence of methane or other hydrocarbon gases. In other words, the greater the proportion of methane, the hotter the platinum coil becomes. This coil is secured at the end of a stick and connected with a portable storage battery, which heats it. As the current from the battery is maintained constant by a simple automatic control, any variation in the temperature of the coil is caused by the combustion of methane at the surface of the wire.

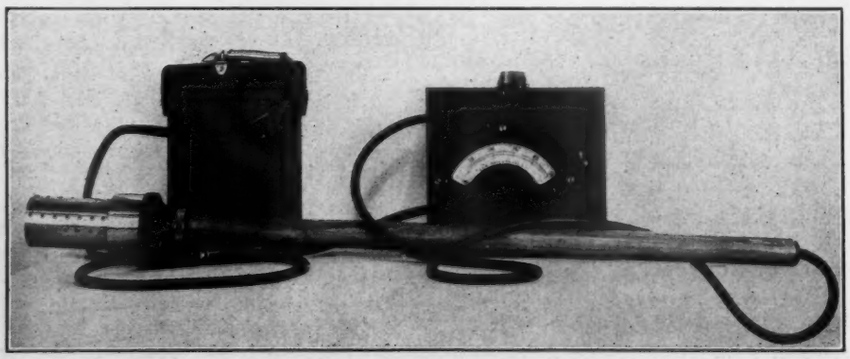
The temperature of the coil is recorded on a dial indicator, which is so calibrated that it registers the amount of methane in the atmosphere around the coil. In order to prevent an explosion, this coil is protected by the same kind of gauze bonnet that was devised by Sir Humphrey Davy for a mine safety lamp a century ago. Since it can be attached to a telescopic stick of any length, this sensitive mechanism can be poked into the highest crevice on a mine level. The battery and the indicator are carried on the fire boss's belt; but the wires connecting the detector to the battery and the indicator can, of course, be run any desired distance. For example, detectors permanently placed in entries could be wired to a recording instrument in the mine office, and be made to ring warning signals when the gas content rises above the danger point. A steady action of the needle registers immediately the presence of an increasing amount of methane; but if there be 5 per cent. of methane in the air—the danger point—the needle will swing back and forth rapidly.

Miner equipped with the portable fire-damp detector.

The detector has met with unvarying success in both laboratory and field tests. Lately, Mr. Judd spent some time in the anthracite-coal regions of Pennsylvania, where he demonstrated the accuracy and the quick action of the new electric fire-damp detector before a group of coal-mine operators and others concerned with the problem—arousing great interest.

At the present rate of increase, the total installation of water-power plants in Canada—which now aggregates 4,833,000 hp.—will easily pass the 5,000,000-hp. mark by the end of 1928. Power development now heads the list of Canadian industries, with a capital investment of $900,000,000.

The Swiss Federal Railways are considering the use of 1-man engines on all their electric passenger and freight trains.



The complete fire-damp-detector outfit. The case at the left contains a battery, and the case at the right holds the indicating mechanism that shows the measure of methane present.

HERBERT GOUVERNEUR OGDEN

WE regret to announce the death of Herbert Gouverneur Ogden, on January 29, at Easton, Pa. Mr. Ogden was 54 years old, and is survived by his widow and six children, all of whom were resident in Geneva, Switzerland, at the time of Mr. Ogden's sudden death.

Herbert Gouverneur Ogden was born in Newark, N. J., in 1873, and was the son of Herbert Gouverneur Ogden, Hydrographic Inspector, United States Coast and Geodetic Survey. His father was a member of the international commission for survey of the boundary line between British Columbia and Alaska in 1893, and was also one of the original members of the Board on Geographic Names. Mr. Ogden's first American ancestor was John Ogden, who came from England in 1640, and who founded the towns of South Hampton and Hempstead, Long Island.

Mr. Ogden was educated in the high schools of Washington, D. C., and took the electrical engineering course at Sibley College, Cornell University—being graduated from that institution in 1897. He studied law at Georgetown University and at George Washington University, and was admitted to the bar in 1901. Moving to New York City a year later, he identified himself with the law firm of Dickerson, Brown, Raegener & Binney; and in 1907 he became a member of the firm of Binney & Ogden.

Subsequently, Mr. Ogden joined the firm of Sheffield & Betts, and still later he became the senior member of the firm of Ogden & Sheldon. He was the attorney for the Marconi Company until that company merged with the Radio Corporation of America. In 1919, he entered the service of the Ingersoll-Rand Company, and assumed the responsible duties of head of the legal department of that company—his work being largely devoted to important patent and allied matters. He was engaged on patent problems at one of the plants of the Ingersoll-Rand Company when he died.

AUTOMATIC TESTER FOR VACUUM TUBES

LEADING American vacuum-tube manufacturers are now testing radio tubes by machinery. The device consists of a revolving disk, several feet in diameter, with sockets for the tubes mounted on one face. As it revolves, the tubes are connected successively to circuits which test them for the characteristics essential to a good tube. If one fails to measure up to standard, an electromagnetic plunger, located behind the machine, pushes the tube into a basket for further examination. While the most expert human operators can test only 2,000 tubes a day, this machine easily examines 30,000, and does the work with a much higher degree of accuracy.—*Tech Engineering News.*

Compressed Air In Nature

Variations in Atmospheric Pressure Produce Many Puzzling And Spectacular Weather Phenomena

By CHARLES FITZHUGH TALMAN

THE principle of that antique air-compressing device, the trompe, is familiar to most engineers. A column of water descends centrally through a tube larger in diameter than itself. The falling water drags down the adjacent air, which is thus compressed in a chamber at the bottom. This contrivance has been used at various times for blowing blast furnaces, for ventilating buildings, and for driving pneumatic machinery.

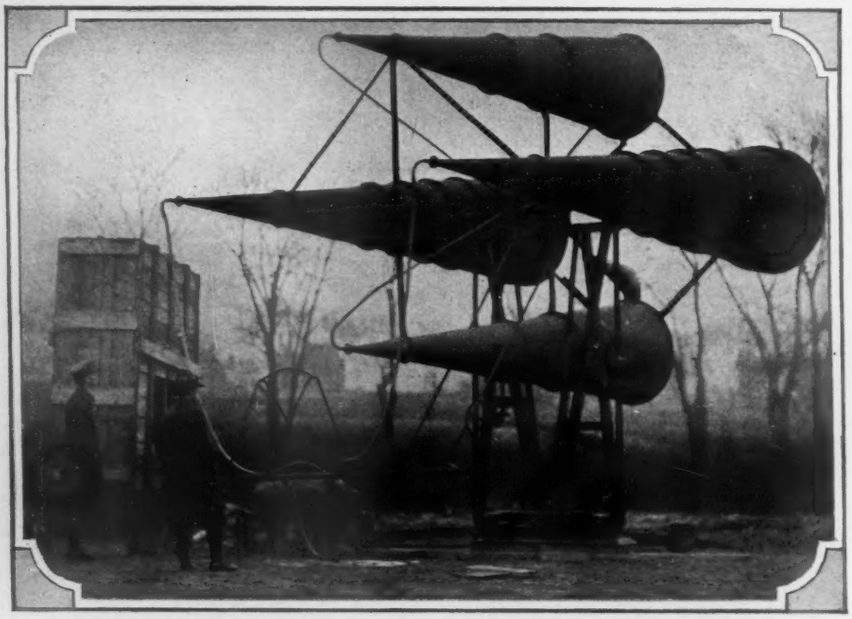
Suppose a shower of rain is falling over an area of several acres. Here we seem, at first sight, to have a natural trompe on a vast scale. The raindrops descend from a height of half a mile or more. The amount of water falling at a given instant may be great enough to produce an eighth of an inch of rainfall, or about 14 tons to the acre. Obviously, the drag of all this water on the air about it is a gigantic force tending to compress the air at the earth's surface—yet the barometer shows that no such compression actually occurs. Why not?

The explanation of this mystery was fully set forth by Dr. W. J. Humphreys, of the Weather Bureau, in the *Monthly Weather Review* of September, 1921. It is somewhat too long for repetition here; but the gist of it is that before the shower there is a certain amount of water vapor aloft—contributing its weight to the total pressure of the atmosphere, and that some of this vapor condenses into drops of water which, in falling, soon acquire a steady velocity at which their downward drag on the air is equal to their weight and therefore equal to the weight of the vapor that was withdrawn from the atmosphere by their condensation. Thus pressure due to drag merely replaces an equivalent pressure due to the weight of water vapor, and the resulting pressure at the surface of the earth is not increased.

"Flashing arcs", or visible sound waves, caused by explosions during an eruption of Vesuvius. This combination photograph and drawing is by Prof. F. A. Perret.

Nature's trompe is not the rainstorm, but the waterfall. In the case of the latter, the drag of the falling water is not offset by any reduction in the weight of the atmosphere above. It is therefore effective in producing a downward push—the air at the foot of the cataract being compressed, not greatly, since it is not confined, but enough to cause ascending air currents, the presence of which is revealed by the cloud of mist and spray they carry aloft. Now let us glance at a few other examples of natural air compression.

This cloud is the world-renowned "table cloth" spreading over Table Mountain in South Africa. The ragged lower edge of the cloud marks the level where the descending air is so much warmed by compression that the cloud particles evaporate.



Sound-ranging horns for locating aircraft. All the phenomena of atmospheric acoustics depend upon the compression of air.

The engineer does not ordinarily think of air as "compressed" unless its density is at least two or three times that of the free atmosphere at sea level. This conception ignores the fact that the air we breathe at the earth's surface is very much compressed in comparison with the air at high levels. It is, for example, three or four times as dense as the air attained in an ordinary pilot-balloon ascent, and a million or more times as dense as that through which pass the loftiest visible discharges of the aurora. Indeed, the compression of the air at sea level under the enormous burden of the gaseous ocean above—amounting to upwards of 5,000,000,000,000,000 long tons—is one of the striking facts of nature. It has many practical consequences, apart from making the earth habitable for breathing creatures. To mention but two of the most familiar, it is the energy stored up in the air by virtue of natural compression that enables us to suck liquids through a straw and to operate vacuum cleaners.

Air compression attends many of the natural movements of the atmosphere, and plays a prominent part in the phenomena of wind and weather. The "highs" depicted on the weather map are regions of compressed air. The blowing of a wind against an obstacle entails the compression of air. Especially interesting are the results of the compression that air invariably undergoes when it descends.

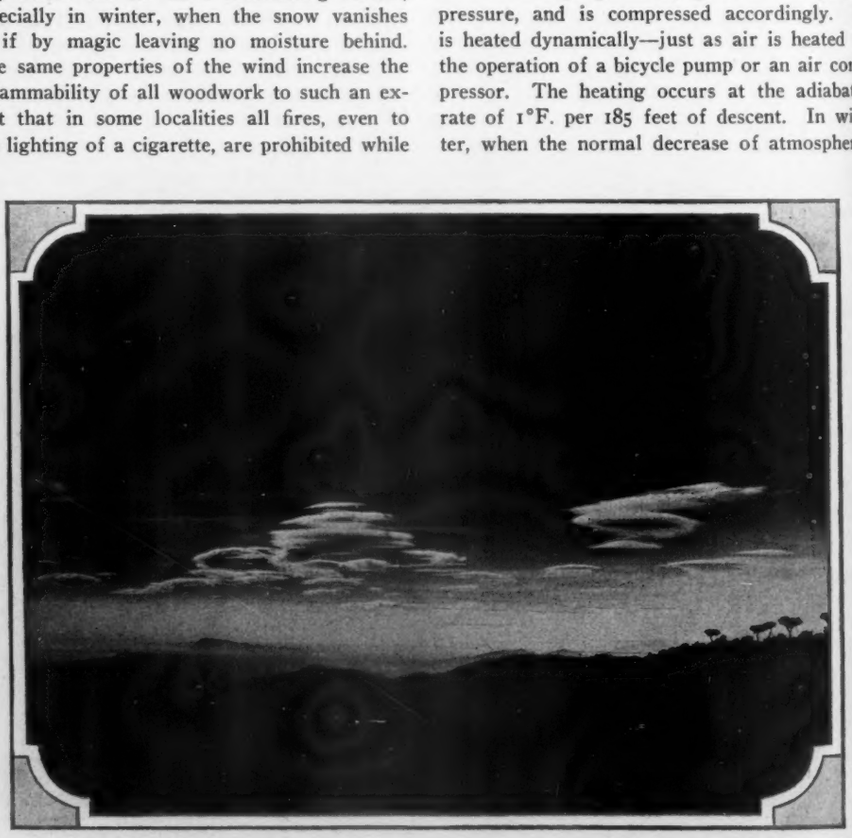
The Alpine valleys of northern Switzerland are frequently visited by a warm, dry, southerly wind known as the *foehn*. The effects of this wind are so remarkable that it is easily the most famous climatic feature of the regions where it occurs. The signs of its coming are well known to the natives. The air is exceedingly clear and transparent, and the mountains seem nearer than usual. In the sky to the southward are often seen almond-shaped clouds, translucent at the edges, the lenticular clouds of meteorological classification. Soon the southern horizon is blotted out by the formation along the mountain summits of a great cloud bank, known as the *foehn* wall.

Following a brief period of complete calm, the *foehn* bursts into the valleys with tremendous violence. Trees are snapped off, cottages unroofed, and the air is filled with dust. The combined heat and dryness of the wind are responsible for its most astonishing effects, especially in winter, when the snow vanishes as if by magic leaving no moisture behind. The same properties of the wind increase the inflammability of all woodwork to such an extent that in some localities all fires, even to the lighting of a cigarette, are prohibited while the *foehn* is blowing. Despite these precautions, *foehn* fires have often laid Alpine villages in ashes. On many people the wind has a pathological effect, the symptoms of which—including headache, lassitude, and depression—are described as *foehn* sickness.

Soon after the middle of the last century a lively discussion raged in scientific circles concerning the origin of the Swiss *foehn*. As the wind is hot and dry, and comes from the south, the belief prevailed for a time that it blew from the Sahara Desert. The great German meteorologist Dove showed that a wind blowing north from the Sahara would be deflected to the eastward by the earth's rotation and thus would never reach Switzerland, and he suggested the West Indies as its place of origin. The correct explanation of the wind was propounded in 1866 by Julius Hann.

The *foehn* is merely a local episode in the flow of a stream of air northward over central Europe, as part of the circulation about a barometric depression to the westward. The air comes from a relatively warm region, and is both warm and moist before reaching the southern slopes of the Alps. In ascending the slopes, the air—rising into regions of diminished atmospheric pressure—expands and cools dynamically. The cooling causes some of its moisture to condense and to fall as rain or snow. This process liberates latent heat, which checks the fall in temperature of the ascending air so that it is still comparatively warm when it reaches the tops of the mountains.

In descending the leeward slopes, the air comes under progressively greater atmospheric pressure, and is compressed accordingly. It is heated dynamically—just as air is heated in the operation of a bicycle pump or an air compressor. The heating occurs at the adiabatic rate of 1°F. per 185 feet of descent. In winter, when the normal decrease of atmospheric



The lenticular clouds that are a characteristic sign of "foehn" weather in the Alps.

Angmagsalik, on the east coast of Greenland. Along this coast the blowing of the "foehn" has been known to raise the temperature nearly 50°F. in four hours.

temperature with increase of altitude—vertical temperature gradient or lapse rate, in scientific language—is small, this rapid heating of the air as it flows down the mountainside causes it to reach the valley below as a relatively hot wind. Lastly, having been robbed of most of its moisture on the leeward slopes, and having had its capacity for moisture increased with its increase of temperature during descent, it also arrives as a dry wind—that is, a wind of low relative humidity.

Precisely the same process occurs in other mountainous regions of the world. Some of the most striking *foehn* effects are found on the shores of Greenland, where the powerful blasts that rush down the slopes of the great ice cap are so much heated that they almost turn winter into summer along the coast. Under the name of chinook the *foehn* is a well-known climatic phenomenon of the eastern Rocky Mountain slopes in North America. Cases are recorded in which chinooks have raised the temperature 40 degrees in 15 minutes and as much as 100 degrees in a few days.

The violence of the *foehn* in the Alps and in some other regions is explained by the steepness of the slopes down which the wind travels. The force of the chinook is determined by barometric gradients rather than topography, and this wind varies in strength from a gentle breeze to a gale.

The lenticular clouds that we have mentioned in connection with the *foehn* are formed at the crests of standing waves in the atmosphere, where the air is forced upward in flowing over the mountains. In its ascent it is cooled by expansion, and some of its moisture changes from invisible vapor to cloud—the first stage in the process of condensation that eventually mantles the summits with the *foehn* wall and generally leads to copious precipitation on the windward slopes. The dynamic cooling of ascending moist air is the commonest cloud-making process in nature, and the dissipation of clouds by evaporation in air that has been dynamically heated in descent is almost equally common. Both processes may be seen in operation side by side in several familiar types of sky in which the clouds are arranged in long windrows or in parallel ranks of cloudlets. Such appearances result when systems of waves are set up at the interface between two distinct streams of air, one above the other, differing in motion and generally in temperature and humidity. The crests of the waves are cooled by expansion and the troughs are warmed by compression—causing, respectively, the condensation and the evaporation of moisture.

It is the warming of the air, compressed in its descent, that dissolves away the lower margin of the famous "table cloth" which moist winds spread over the flat summit of Table Mountain, in South Africa; and the same process causes the clear space of half a mile or more between the "helm" and the "bar" of the Crossfell Range in the English Lake country—a pair of clouds figuring in most works on meteorology.

The tendency of scattered clouds to disappear after sunset—when, according to proverbial weather lore they are "eaten by the moon"—illustrates a process of dynamic heating that involves a paradox. When the sun's rays are withdrawn, the clouds radiate more heat than they absorb, grow rapidly colder, and cool the air adjacent to them, which thus becomes denser than the surrounding clear atmosphere. The chilled air sinks until it is again in equilibrium with the air about it. In sinking, it is heated by compression, and when it finally reaches the equilibrium level it is warmer than it was before the clouds cooled it and started it downward. It has been warmed by cooling! Not only are the clouds evaporated in this process, but the air becomes drier—in terms of relative humidity—than it was at the beginning.

Nature is a clumsy mechanic compared with man. Hence, when she undertakes to produce a compressed-air whistle the result would hardly pass muster for use at the fog-signal stations of the Lighthouse Service. The whistle in question is known as a "blowing well." Connected with such a well is a subterranean reservoir containing air. When the barometric pressure is high outside, then air bubbles through the water in the well; enters the underground chamber; and compresses the enclosed air. When the barometer falls, air passes in the other direction. The whistling generally depends upon the coöperation of man in providing a cover, through the crevices of

A peach orchard, on a mountainside, that is protected from frost by natural air compression. The smoke from a burning stump reveals the downward flow of air, which is compressed in its descent and warmed along a so-called thermal zone.

Clouds of the windrow type. The spaces between the clouds are regions of compression in the troughs of aerial waves.

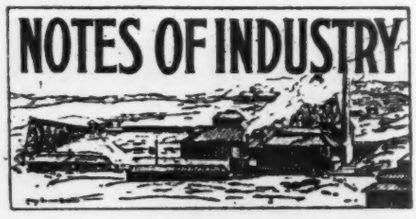
which the air makes a noisy exit. Some blowing wells have been equipped with real whistles, so that they may announce a fall of the barometer and the probable approach of a storm.

All sounds transmitted through the atmosphere depend, of course, upon the compression of air. The spherical compression waves involved in acoustic phenomena are occasionally visible as "flashing arcs," such as were described a few years ago by Prof. F. A. Perret, the volcanologist. Watching the cloud of smoke and dust over Vesuvius during an eruption, he noticed that at each explosive outburst a thin luminous ring flashed outward and disappeared into space. The speed at which those rings moved corresponded with the speed of sound in air, so that there could be little doubt that they were actually sound waves made visible by the refraction of light. During the World War similar luminous arcs were seen sweeping over the landscape when heavy cannonading was in progress.

GREAT CENTRAL HEATING SYSTEM FOR PARIS

IN the February issue of *Compressed Air Magazine* mention was made of a proposed central-heating system for the entire City of Paris. It is now reported that the plan has been adopted by the Municipal Council of Paris, and that the initial work on the project has been awarded to private enterprise. The contract calls for the laying, within a period of five years, of 3.7 miles of mains through which heat is to be supplied to 7,000 apartments. The cost per mile of main is estimated at approximately $515,000.

To facilitate maintenance and repair, the conduits will be run through tunnels that are to be built large enough to accommodate ultimately the existing gas, electric, and water lines. As previously mentioned, the abandoned power station on the Quai de la Rapée is to be converted into a steam plant, the first in a far-flung system that is eventually to reach into every quarter of that great metropolis.



Work is soon to be undertaken on a dam near Hohenwarte, in southwestern Germany, for the purpose of harnessing the falling waters of the River Saale. The dam is to be 250 feet high, and will impound 6,700,000,000 cubic feet of water that will have a head varying between 90 and 220 feet. It is said that the structure will be one of the largest of its kind in Europe.

Transatlantic mail arriving at Canadian ports during the cold months, and destined for the interior, is to be transferred from ship to shore by amphibian planes designed especially for winter service. The machines are to be equipped with skis for landing on ice and with pontoons for alighting on water.

Since 1914, when the importation of refrigerated meat, etc., into France was limited owing, among other things, to the lack of proper facilities for handling and storing, the traffic in foodstuffs of this kind has undergone a marked change. There are now employed in this service a fleet of 24 vessels designed exclusively for the carriage of perishable commodities; about 2,000 refrigerator cars are operated by the French railways; and 80 cold-storage warehouses, not including small plants, are located throughout France. The war had much to do in bringing about this change, as necessity compelled the lifting of the bars that had previously hampered the sale especially of refrigerated meats in that country.

There are now in operation between New York City and Los Angeles, Calif., two direct telephone circuits, each with a length of 3,273 miles. An average of 51 calls a day is handled over these wires.

The world's first floating dock for airplanes was launched not long ago at a shipyard in Lübeck, Germany. This dock has a supporting capacity of 1,000 tons, which is considerably in excess of the needs of the largest seaplanes now operated by the German *Lufthansa*. The heaviest of these flying machines weighs only 23 tons. The structure is designed not only to facilitate the company's airplane traffic but is also to be used in connection with experiments looking towards transatlantic service.

The new direct Rome-to-Naples railroad, that was opened to traffic recently, shortens the run between the capital and the southern seaport by 20½ miles. For about 21 miles of its 134-mile stretch the road passes through numerous tunnels. Two of these are 4.3 miles long each, and two others have a length of a little more than 3 miles each.

A veritable mountain of candy was consumed by the American people in 1926, according to a survey just concluded by the Department of Commerce. The figures reveal that 1,023 manufacturers, representing 80 per cent. of the nation's candymakers, sold 1,083,399,754 pounds, valued at $258,251,562. Divided among the entire population, this meant that every man, woman, and child in the United States ate 9 pounds of confectionery that year.

The difference in the upkeep cost of motor vehicles running over improved and unimproved roads has been made the subject of study by various highway departments. The results, as reported by the American Automobile Association, show that the operating cost of all types of cars is 25 per cent. lower when those cars use hard-surfaced instead of dirt roads. In the case of gravel roads as compared with dirt roads the difference amounts to 10 per cent., and is in favor of the gravel road. These revelations are being turned to good account by the Bureau of Public Roads in determining what highways shall be given preference in deciding on improvements.

A direct rail route from the deep-water harbor at Stewart, B. C., to the Yukon Territory, Alaska, has been planned by Canadian enterprise for the purpose of developing northern British Columbia, particularly the Atlin District. The length of the proposed road is about 500 miles; and it would connect at Carcross with the White Pass & Yukon Railway.

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EDITORIALS

BEAUTY OF NIAGARA FALLS CAN BE PRESERVED

THE grandeur of Niagara Falls as a spectacle has been lessened by erosive action since the white man first looked upon that natural wonder with awe. Even so, greater impairment can be indefinitely postponed if proper steps be taken to divert and to control the movement of the river at that point in its journey seaward. Such is the conclusion of the Special International Niagara Board, appointed jointly by Canada and the United States. This board has made a report after careful consideration of the many phases of the subject.

This report, recently given to the public, tells how the scenic charms can be both safeguarded and also amplified at an expenditure of only $1,750,000. The board has found little to commend in the various more or less elaborate and much more costly plans offered as possible solutions of a problem that has deeply stirred the lovers of natural beauty not only in Canada and the United States, but throughout the whole world.

With a knowledge of the situation and of the conditions that have diminished the impressiveness of the falls, the board is nevertheless convinced that "the falls are in no danger of committing suicide" through progressively increasing erosion. However, the board realizes the damage that has been done to the spectacle, and it is certain that this damage can be neutralized and the beauty of the falls greatly enhanced by simple expedients that call for some rock excavation and for the erection of several submerged weirs. The weirs and the excavations would serve to so distribute the water, at all seasons, as to insure an unbroken crest line, from shore to shore, at the Horseshoe Falls; and other work that would be done in connection with the Grass Island Pool would provide—also at all seasons—an adequate flow of water in the rapids and falls on the American side as well as between the Three Sister Islands.

If, after full discussion, this proffered solution of a long-standing problem prove to be the best one, then the sum involved will be a relatively trifling outlay for the perpetuation of one of America's most noted scenic wonders.

NEW ERA IN OIL-PIPE-LINE PUMPING PLANTS

SUBSTANTIALLY 800,000,000 barrels of oil are distributed in this country, in the course of a year, through the far-flung pipe lines that form the arteries of this system of underground transportation. These pipe lines have a combined length of something like 100,000 miles—such has been the development of this method of conveying petroleum since the first successful oil pipe line was built by Samuel Van Sickle in 1865.

As can be readily understood, the pumping plants forming essential features of these pipe lines have called for the exercise of much engineering thought and skill; and, like everything else in this progressive world, changes have been made from time to time—the aim being to obtain operating economies by adopting equipment of higher efficiency. The latest departure in this direction has been the substitution of electrically driven centrifugal pumps for reciprocating pumps heretofore widely employed to move oil through the pipe lines.

The change to centrifugal pumps is the outcome of notable pioneer work done about three years ago by the progressive manufacturers of certain well-known types of pumps. The object then was to determine whether or not centrifugal pumps would or would not cause emulsification of the oil and the water associated with the oil as it came from the ground. In the case of reciprocating pumps considerable emulsification takes place—the resultant "B. S.", as the oilman terms the product, being unmarketable and, therefore, a loss.

The tests in question were classic in their revelations, and showed convincingly that properly designed centrifugal pumps are distinctly superior for pipe-line work. Not only that, but those researches disclosed that the amount of emulsification was negligible even when abnormal percentages of water were purposely added to the oil just before the oil reached the centrifugal pump!

It has been authoritatively estimated that reciprocating pumps are in the main responsible for the annual production of about 20,000,000 barrels of emulsion; and the potential avoidance of this source of loss by the substitution of centrifugal pumps offers a way to effect a very substantial saving to the industry. This is not the whole story of the gain that can be made: the utilization of electrically driven centrifugal pumps promotes other operating economies of imposing magnitude—savings that would still be the subject of debate, ground for differing opinions, but for the initiative of the company that established conclusively the superiority of the centrifugal pump for work in this rather exacting field of service.

MEMORIAL LIGHTHOUSE TO COLUMBUS

AFTER numerous preliminaries, plans have at last been crystallized to rear at the entrance to the Port of Santo Domingo a suitable memorial lighthouse that shall commemorate the guiding pioneer spirit of CHRISTOPHER COLUMBUS, the discovery of America, and the establishment of the first European colony in the western hemisphere.

Secretary KELLOGG recently announced that competitive designs for the memorial would be considered from architects the world over—giving to the project an international appeal because of the world-wide consequences of the discoveries made by COLUMBUS. Already, the Santo Domingan Government has granted land for the lighthouse, and has generously appropriated $300,000 to meet preparatory expenses. The ultimate cost of building the memorial is to be shared jointly by all the nations of North and South America. Very properly, the Harbor of Santo Domingo was chosen as the site of the memorial, because it was at Santo Domingo that COLUMBUS planted a colony made up of some of the people aboard the wrecked *Santa Maria* and others from the personnel of the two surviving ships of his little fleet.

Within the commemorative edifice there will be a crypt; and, when this is completed, the intention is to place there all that now remains of the mortal body of CHRISTOPHER COLUMBUS. This procedure is quite appropriate in purpose; but we are fearful that the project will revive controversy, because it has never been established beyond dispute that the bones now reposing in the cathedral in the City of Santo Domingo, and reputed to be those of CHRISTOPHER COLUMBUS, are in fact his. Possibly, ancient records and evidence may be available by that time to put this matter incontestably aright.

Santo Domingo enjoys a pivotal position in relations to shipping bound north and south between the Americas and steaming east and west to and from the Panama Canal. Similarly, its position is equally significant in view of what may eventually be the principal course of aircraft traveling between these continents. A flaming beacon commemorative of the courage, the vision, and the perseverance of COLUMBUS will shine at this meeting of air and water lanes to hearten the navigator onward and to fill him with something of that spirit that opened a new world of amazing wonders to mankind. It will serve also to promote intercourse and to stimulate that friendly feeling born of closer contact.

TO HUNT THE CAUSE OF THE COMMON COLD

THE microscope and the test tube of the bacteriologist have disclosed many minute organisms responsible for a wide range of human ills; and, having discovered those sources of bodily trouble, other investigators have turned to and, in many instances, devised

effective ways of battling with those tiny causes of physical derangement. But while all this work has gone forward triumphantly and, at times, with spectacular success, still the particular germ—the evil genius of the common cold—has escaped detection or identification. As a consequence, humankind pays an annual penalty that is variously estimated to represent a reduction in efficiency—if not entailing death—having a monetary equivalent ranging anywhere from millions to billions.

The Chemical Foundation has set about to alter this situation; and it has provided a fund of $195,000 which it has turned over to the Johns Hopkins School of Medicine to run this vexatious and virulent pest to earth, and, with this achieved, to develop methods or means wherewith to render its activities harmless or futile. The common cold is bad enough considered alone, because no matter how slight its manifestations it is an indisputable brake on the efficient operation of one's mental and physical processes. But the sinister and graver character of the common cold lies in the way in which it may lead to pneumonia and to secondary infections that are often obstinate in their resistance to curative agencies. The problem of the researchers will, therefore, be manifold; and the collaborative skill of a number of departments of medicine will be called upon to deal with the elusive germ in question.

One and all of us wish the investigators of that world-famed Maryland institution success in the work ahead of them. The whole universe will have cause to rejoice if those men succeed in isolating the responsible germ and then in evolving treatments or preventive measures that will render impotent this microscopic promoter of so much misery. Mankind will have every reason to hail with delight that day in the future when the cold ceases to be a commonplace and becomes, instead, a pathological rarity.

COMBINING FOR BROADER SERVICE

THE recent organization of the United Engineers & Constructors, Inc., represents a consolidation of experienced forces having for its primary purpose the function of building and operating large utilities. According to the daily press, this new enterprise already has in hand contracts aggregating a value of more than $100,000,000.

The four well-known companies directly interested in the organization are the Public Service Production Company, the United Gas Improvement Contracting Company, the Day & Zimmerman Engineering & Construction Company, and Dwight P. Robinson & Company. The president is Dwight P. Robinson.

The United Gas Improvement Contracting Company and the Public Service Production Company have been intimately identified for some years in the construction of plants and distributing systems of public-service gas and electric utilities; and the work done by them has been of an extensive nature. Similarly, the Day & Zimmerman Engineering & Construction Company and Dwight P. Robinson & Company have had to do with many large power plants, transmission lines, and other engineering projects of a varied and a more or less monumental character. The consolidation of these several companies brings into being an organization especially fitted to deal competently with big undertakings in a wide field of service and to do the work involved expeditiously and advantageously to all the interests concerned.

STEEL AND ITS HEAT TREATMENT, by D. K. Bullens, Consulting Metallurgist. An illustrated work of 564 pages, published by John Wiley & Sons, Inc., New York City. Price, $5.00.

THIS is the third edition of this admirable volume, and has been issued because of the many advances made in recent years in metallurgical science and the art of heat-treating steel. In order to bring the book up to date, the author has rewritten a great deal of the original text and has introduced much new matter bearing directly on present-day practices.

For the purpose of ready reference, the work has been divided into three main sections dealing, respectively, with the metallurgical, the engineering, and the production aspects of the subject. All these have been handled in an authoritative and comprehensive manner. The book should prove a welcome addition to the shelf of any one interested in this important field of an industrial activity that reaches into so many departments of modern life.

IRON AND STEEL, by H. M. Boylston, Professor of Metallurgy, Case School of Applied Science. An illustrated volume of 571 pages, published by John Wiley & Sons, Inc., New York City. Price, $5.00.

THE purpose of this volume is twofold: to be a source of guidance to young students in engineering schools and to aid men in steel mills who desire to obtain a better understanding of the materials with which they work. The author has sought to explain in a straightforward manner and in simple English the fundamentals of iron and steel making; and an examination of the book reveals that he has succeeded commendably in his self-imposed task.

The production of iron and steel has expanded enormously in the last two decades; and to appreciate this a review of what has been achieved is necessary from time to time. The author has made this onward march understandable, and he has also emphasized the essential steps upon which this advance rests. A knowledge of these fundamentals is necessary both to those engaged in the making of iron and steel and to those who utilize the finished products.

ACETATE SILK AND ITS DYES, by Charles E. Mullin, with a foreword by Louis A. Olney. An illustrated work of 473 pages, published by the D. Van Nostrand Company, Inc., New York City. Price, $6.00.

ACETATE silk, popularly known as rayon, is the infant prodigy of the textile industry. As is well known, at the present time, all the rayons are in unprecedented demand; but acetate silk, by reason of its dyeing properties alone, holds a certain definite field of usefulness upon which none of the older rayons can even encroach. Yet only a few years ago it was these very dyeing properties, or, as it was then thought, the lack of dyeing properties that restricted the use of this wonderful fabric. Mr. Mullin's book reveals how acetate silk can be dyed and results obtained that were believed impossible of attainment not so long ago.

HOW TO MAKE A MODEL OF THE U. S. FRIGATE CONSTITUTION, by Captain E. Armitage McCann. An illustrated volume of 205 pages, published by The Norman W. Henley Publishing Company, New York City. Price, $2.50.

THIS is the third volume of a series, by the same author, telling how to build artistic models, faithful in all essential details, of a number of picturesque types of sailing craft. For the man or boy fond of woodworking, and with a constructive bent, model making of this sort provides a fascinating way to utilize spare time and to produce in the end something well worth having as an evidence of hours of agreeable and instructive occupation.

Dealing as it does with the historic *Constitution*—affectionately known as *Old Ironsides*, the book is especially timely and all the more worth while because the splendid original is now undergoing rehabilitation, thanks to funds made available mainly by the patriotic school children of the country.

THE METALLURGIST'S MANUAL, by T. G. Bamford and Harold Harris. An illustrated work of 246 pages, published by D. Van Nostrand Company, New York City. Price, $5.00.

METALLURGY plays so big a part in modern industry—carrying its benefits to every walk of life—that a book designed to help the metallurgist in his diversified field of service should be welcome. As the authors modestly express it, they believe that the book will not only serve students in universities and technical schools but will be found an aid in refreshing the memories of even skilled men upon many points which arise in the conduct of industry. We are convinced that the volume will more than meet these expectations.

The Harnischfeger Corporation, Milwaukee, Wis., has issued a bulletin which describes its new Model 300 trench hoe. This bulletin should be of interest to contractors and others engaged in excavating for one purpose or another.

A new illustrated bulletin is now available describing the varied uses of the Maxim silencer. This brochure can be obtained gratis by application to The Maxim Silencer Company, Hartford, Conn.

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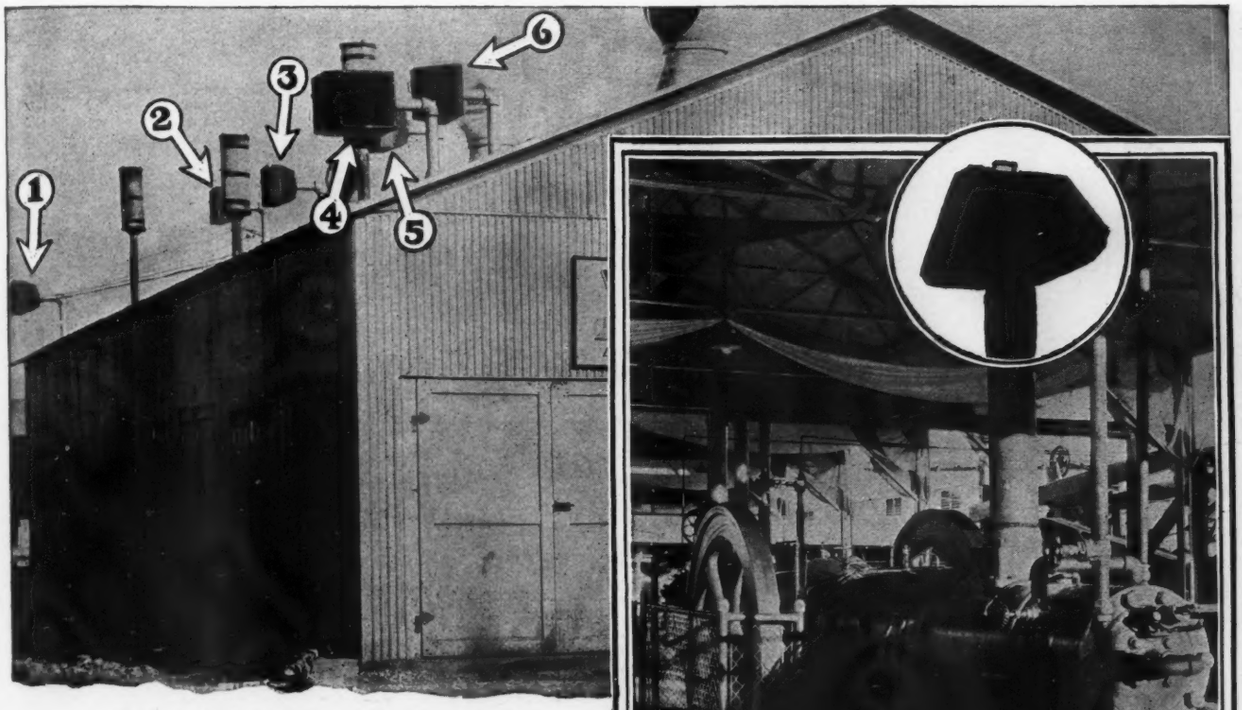

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AT the recent International Petroleum Exposition in Tulsa, Oklahoma, nine prominent engine and compressor manufacturers — *over 80% of the exhibitors*—equipped their demonstration machines with Reed Air Filters. Striking evidence of the preference for Reed equipment by engine and compressor builders themselves. Reed Filters, easily installed on the intake, remove 97% to 99% of all dust, dirt and grit from the air, prevent scored pistons, clogged valves and burnt-out bearings, maintain the original high efficiency of the equipment and prolong its life from 25% to 75%. Investigate today. No obligations. REED AIR FILTER CO., *Incorporated*, 214 Central Ave., Louisville, Kentucky.

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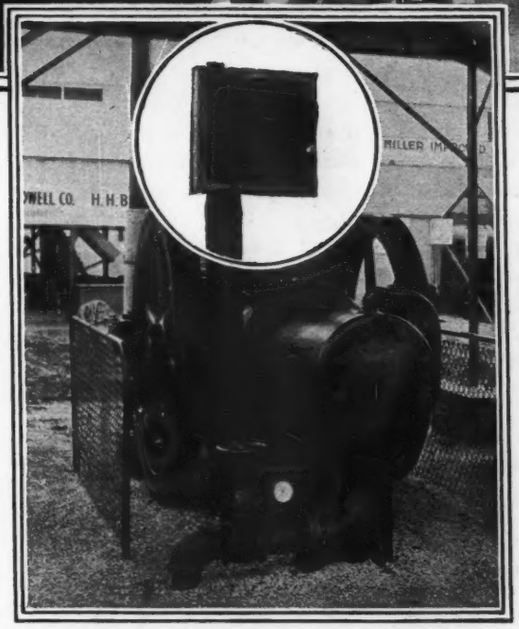


Upper Right: Two-unit Type S. C. F. Reed Filter installed on a Clark Bros. Co. engine at the Tulsa Exposition. *Lower Right:* Cooper engine equipped with one-unit Type S. C. F. Filter.

Reed Air

TRADE *filters* ALL METAL MARK

Use This

REED AIR FILTER CO., *Incorporated*
214 Central Ave., Louisville, Kentucky

Send, without obligating me, your Bulletin No. 110 on clean air for Air Compressors, Internal Combustion Engines and Pneumatic Equipment.

Name..... City..... Possible Use.....

Company..... State.....

"For Every Joint On the Line"

VICTAULIC COUPLINGS

VICTAULIC Couplings are regularly specified for water and air lines in many mines, by leading companies that produce and distribute oil, natural and manufactured gas, for water and sewage lines and for many uses in process products manufacture.

Victaulic Couplings are installed faster than any other coupling, far faster than threaded, flanged or caulked joints can be made—AND UNSKILLED LABOR DOES ALL THE WORK. Two minutes is the average time of connecting two lengths of pipe with a Victaulic Coupling. The only tool needed is a wrench.

Victaulic Couplings give flexibility to the line, even when under pressure. They take care of contraction and expansion of the pipe lengths and eliminate the need of swing joints or expansion bends. A line connected with Victaulic Couplings permits the removal of any section of pipe without injury to the pipe and without disturbing any adjoining length.

Available for all sizes of steel, wrought iron and cast iron pipe, Victaulic Couplings can be supplied for any pressure from vacuum to ten tons pressure per square inch.

For list of uses and users, typical installations and detailed information write for Victaulic Bulletin No. 5

The all-purpose couplings

VICTAULIC COMPANY OF AMERICA

26 Broadway New York

FLEXIBLE LEAK-PROOF

VICTAULIC

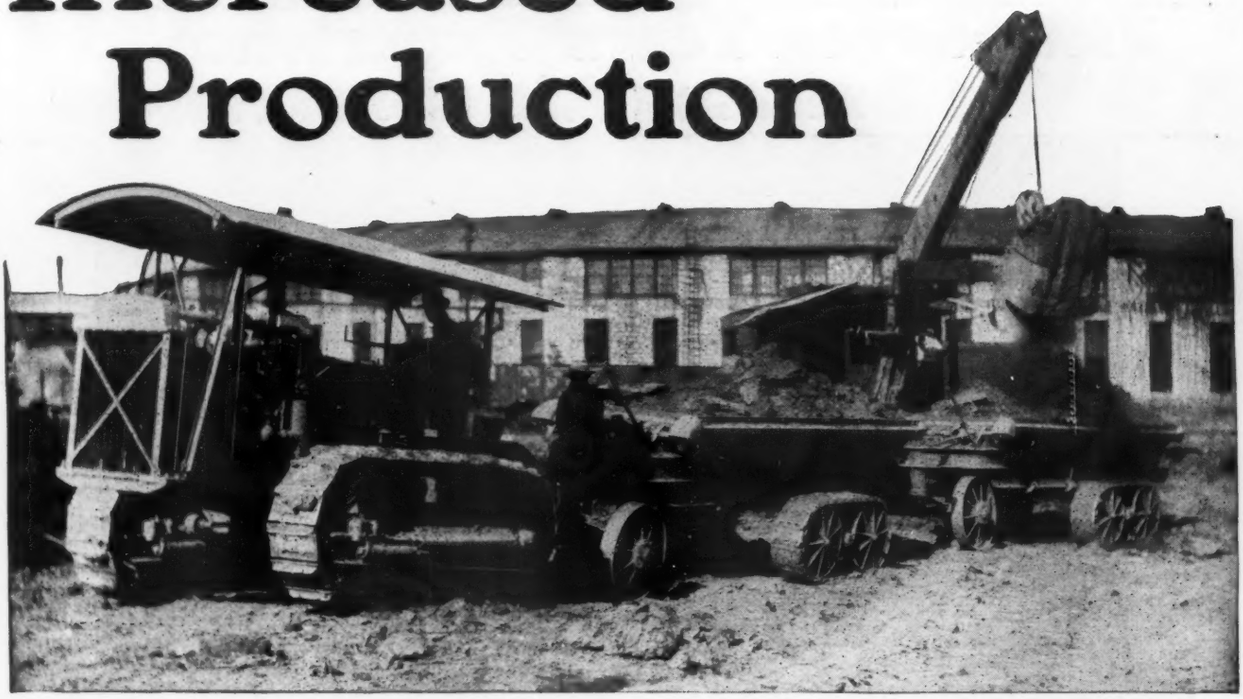
REG. U.S. PAT. OFF.

PIPE COUPLINGS

FOR OIL, GAS, WATER, SEWAGE, COMPRESSED AIR, ETC.

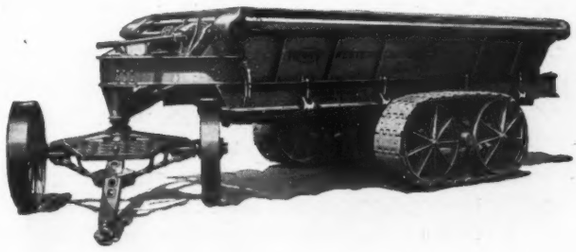
"For every joint on the line"

Increased Production



The Western 7-yard Crawler Dump Wagon Used in Tandem in Railroad Work

Increased production is the pot of gold at the end of the rainbow. You can find it by using Western 7-yard Crawler Dump Wagons. This wagon increases production. Its broad crawler wheels will carry the huge 7-yard load any place a crawler-type tractor can operate. Mud, sand or rough ground do not stop this wagon. Hot weather does not affect it. A 24-hour day is possible with a tireless motorized outfit.



The operating view shows Western 7-yard Crawler Dump Wagons in railroad work at Emporia, Kansas. They were put to work when round wheel wagons could not be operated in the mud. The Crawler Wagons were able to carry on in spite of poor haulage conditions. They increased production.

In the season that is now opening you too will need increased production. Western 7-yard Crawler Dump Wagons will be your best insurance. Bulletin 27-SCM gives detailed information. Write for a copy today.

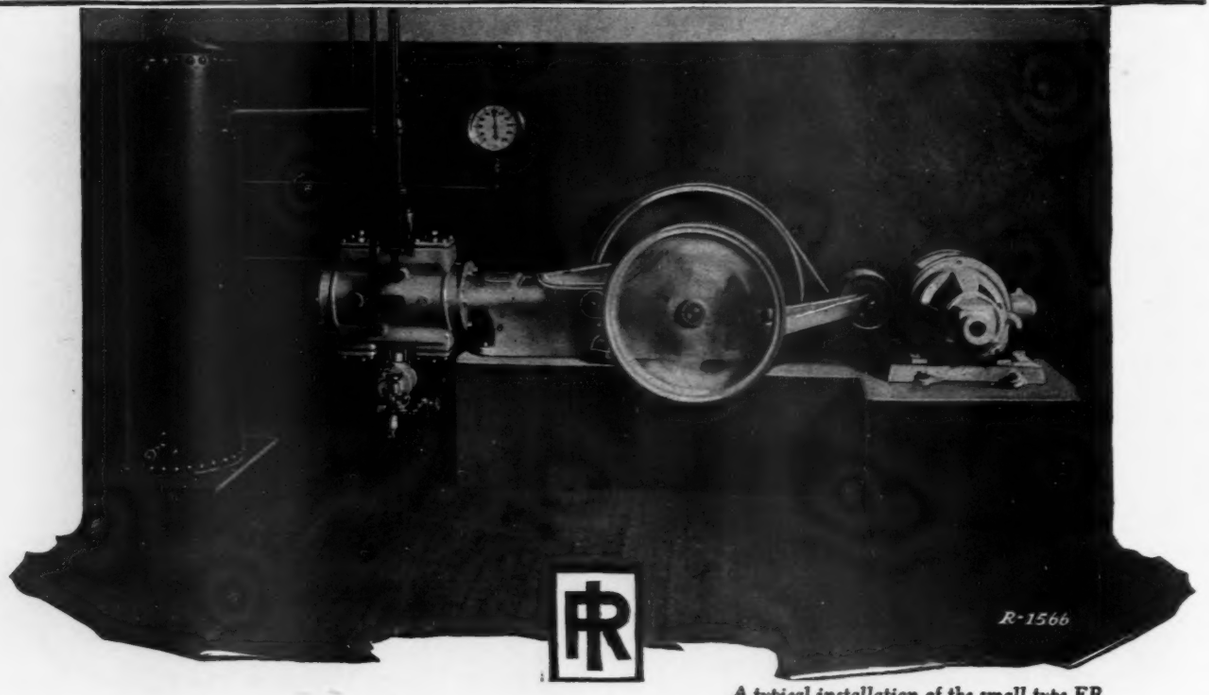
Western

WESTERN WHEELED SCRAPER COMPANY

Dump Cars and Grading Equipment

AURORA, ILLINOIS, U. S. A.

Fifty-Seven Years' Experience in Building Air Compressors



A typical installation of the small type ER Compressor which is widely used in all parts of the world in all kinds of work.

Branch Offices in the U. S. A.

ATLANTA	KNOXVILLE
BIRMINGHAM	LOS ANGELES
BOSTON	NEWARK
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BUTTE	NEW ORLEANS
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DENVER	SALT LAKE CITY
DULUTH	SCRANTON
EL PASO	SEATTLE
HARTFORD	ST. LOUIS
JOPLIN	ST. PAUL
WASHINGTON	

After 57 years of practical engineering experience in designing and building Air Compressors, getting our hands as grimy as the next man's while working in both our own and customers' plants, we truly feel that we know what the trade wants and how Compressors should be built.

This intimate experience with Compressed Air problems is reflected in our standard machines—there are over a thousand sizes and types ranging in capacities from seven to seven thousand cubic feet of free air per minute. The correct machine can be furnished for any set of conditions and any kind of drive, whether it be belt-driven or direct-connected to synchronous motors, or oil, steam or gas engines.

The Company's representatives are located in cities all over the world and will be glad to help you with your Compressor Air problems.

INGERSOLL-RAND CO., 11 BROADWAY, NEW YORK

Offices in Principal Cities the World Over

Canadian Ingersoll-Rand Co., Ltd., 10 Phillips Square, Montreal, Quebec
Ingersoll-Rand Co., Ltd., 165 Queen Victoria Street, London, E. C. 4

Ingersoll-Rand

896-C

THAT LINDE LABEL means

1 A quality product—the standard for more than 20 years.

2 Fast delivery from the nearest of 152 distributing points.

3 The economical use of oxygen through Linde Process Service.

Incidentally, have you seen the Linde magazine—"Oxy-acetylene Tips?" We'll be glad to send you a copy. It's part of Linde Process Service.

LINDE OXYGEN

THE LINDE AIR PRODUCTS CO.

Unit of Union Carbide and Carbon Corporation

UCC

General Offices:

Carbide and Carbon Building
30 East 42d St., New York

47 Plants 105 Warehouses

CONTENTS OF THIS ISSUE

Vol. XXXIII, No. 3, March, 1928

NOTE—For subscription terms see first editorial page

Articles

Advertisements

Ingersoll-Rand Air line lubricator used with DCR-23 Jackhammer.

Waugh air line oiler lubricating a Gardner-Denver airdrill.

For *Resistance to Oil* . . . "COMMANDER" AIR HOSE!

"COMMANDER"
The de luxe air drill hose. Oil-proof tube; extra-heavy braided cord reinforcement; double thickness, self-armoring cover.

"TYPE 50"
Tough and strong, yet light and easily handled. For pneumatic tools and light air drill service. Oil-resisting tube; multiple braided reinforcement.

"TYPE 88"
A wrapped construction air hose built of the same high-quality materials as "Commander."

Even if you use "line oilers" to lubricate your air drills, you'll find "Commander" standing up to its work months after ordinary air hose has given out.

The inner tube is a special oil-resisting rubber compounded to withstand the action of the most malignant mineral oils, which retains its strength from two to five times as long as ordinary rubber.

The cover is tough, brawny rubber, 50% stronger than you find on ordinary air hose —it will outwear any kind of steel armoring.

For lowest ultimate cost — Goodrich "Commander" Air Hose!

THE B. F. GOODRICH RUBBER CO.
Established 1870 Akron, Ohio

Goodrich AIR HOSE

"Type 50" "COMMANDER" "Type 88"

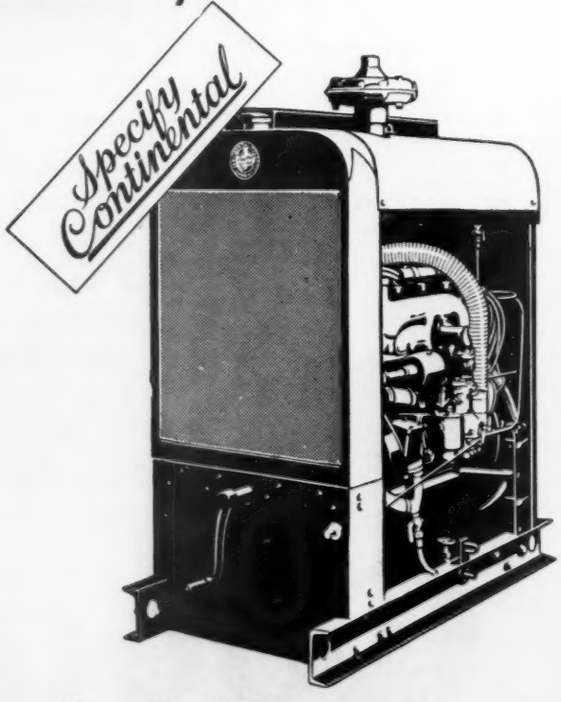
Dependable Power for Every Purpose

Welding unit manufactured by USL Battery Corporation and powered with Red Seal P-35 power unit.

The Heart of Industry

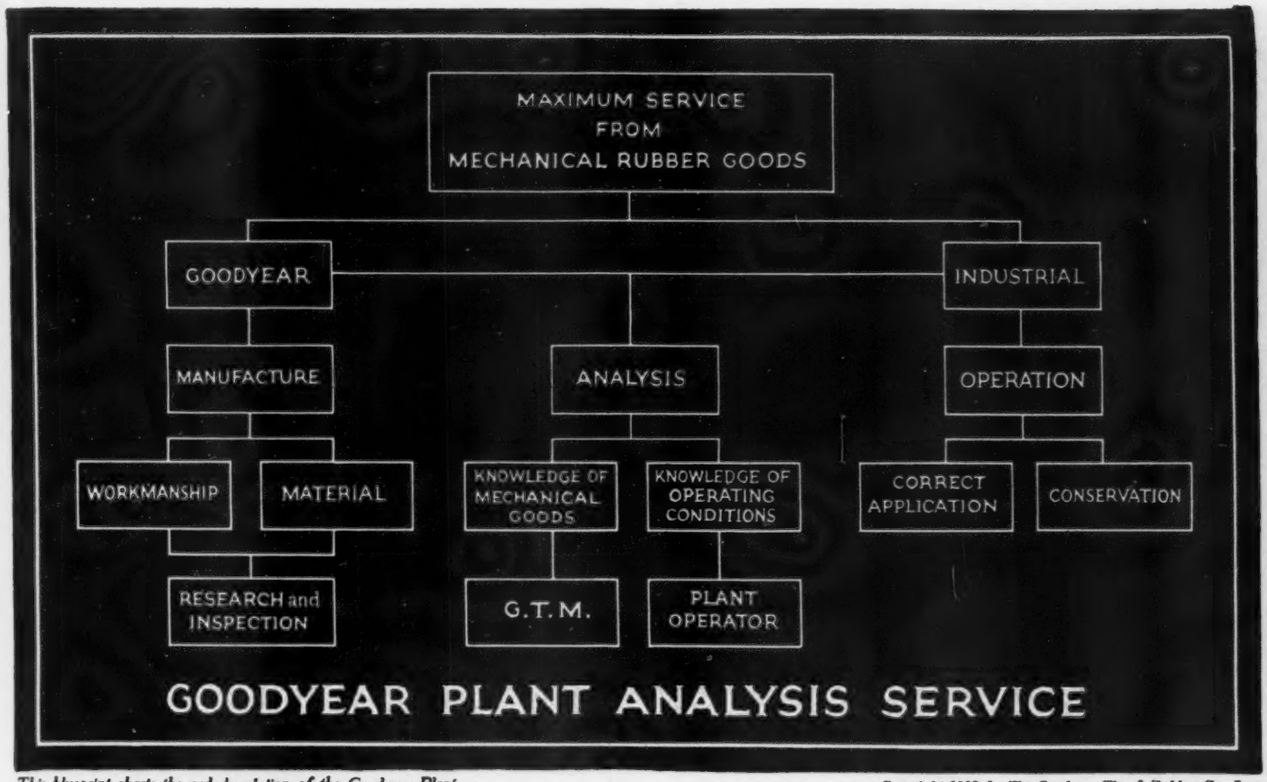
Experienced over the years in interpreting the power needs of an industry, Continental is able to strike right at the heart of industrial necessity by developing special models of industrial engines capable of greater power, more flexibility, better economy and longer life.

There is a complete line of heavy duty Red Seal Continental engines for every industrial need. Specify Continental and enjoy these qualities together with the protection which has contributed to Red Seal leadership in industrial power.



CONTINENTAL MOTORS CORPORATION
INDUSTRIAL EQUIPMENT DIVISION
Office and Factory: Muskegon, Michigan
The Largest Exclusive Motor Manufacturer in the World

Continental Motors



This blueprint charts the orderly relation of the Goodyear Plant Analysis Plan for maximum service from mechanical rubber goods.

The Plant Analysis Plan—and the G. T. M.

This chart is important to every man who has to deal with belting, hose or packing problems. It shows the principal factors in the Goodyear Plant Analysis Plan, and makes clear the part that is played in more efficient, economical plant equipment by the G. T. M.—Goodyear Technical Man.

You know the idea behind the Goodyear Analysis Service. It is simply this, that you are bound to get more work and better work, done more efficiently and more economically, from the *right* mechanical rubber goods, specified to the job. How the *right* product is found by analysis is shown on this blueprint chart.

At the top you see the G. T. M. and your plant operator, each applying his special experience and knowledge to the problem in hand, whether it be a single drive or an entire plant equipment. They make the analysis together.

The G. T. M. is an expert on mechanical rubber goods. He knows their special properties. He is trained in the science of their specification and application. His work takes him into many plants, in many industries, so that he is familiar with most transmission and conveying problems, and is a practical authority on many of them.

When he comes to your plant, he comes as a friendly analyst of your operating problems, your troubles, maybe. He doesn't pretend to know it all. He gladly takes the advice of your superintendent and engineer. He gives close attention to their experienced knowledge of your operating conditions.

His entire purpose is to fit what he knows about belting, hose or packing to the demonstrated conditions of service in your plant. If he can find out what you can use to best advantage, he will recommend it to you. Then, on your order, Goodyear will build your equipment according to those approved specifications. And after it is installed, the G. T. M. will follow it up with a service that will see that you get out of your equipment all the value built into it by this scientific analysis and careful manufacture.

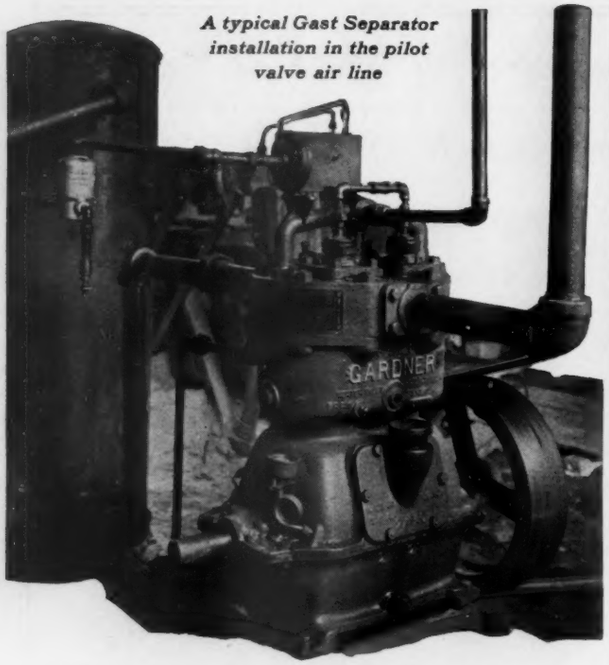
Doesn't it stand to reason that you are likely to get the utmost in trouble-free, long-wearing service out of that kind of equipment? The proof of the Goodyear Analysis Plan is in the records—many of them published in these pages during the past ten years—of better, more productive and more economical work done by G. T. M. specified goods in hundreds of plants, in every line of industry.

There is a G. T. M. in your neighborhood. It may pay you well to have him analyze your needs or problems. If you want to get in touch with him, or receive detailed information about the service Goodyear Mechanical Rubber Goods—belts, hose, valves and packing—are giving in your particular industry, write to Goodyear, Akron, Ohio, or Los Angeles, California.

Goodyear Means Good Wear

VALVES · PACKING BELTS · HOSE

GOODYEAR



A typical Gast Separator installation in the pilot valve air line

Protect your unloaders with Gast Separators

THE unloader is a regulator and a guardian of your compressed air system, and every care should be exercised to keep it in perfect working order. One of the most common troubles encountered is clogging of the pilot valve air line with water and oil. This prevents proper functioning of the unloader and disrupts the whole compressed air system.

A Gast Separator installed in the pilot valve air line will give protection against stoppage at a very small cost. Gast Separators can be used to an advantage wherever the transmission of compressed air is involved.

Gast separators keep water and oil out of all air lines, and save wear and tear of the equipment. The construction is simple and there are no moving parts to get out of order or wear out.

You can test a Gast Separator for 30 days. Write for particulars.

Smith-Monroe Company
1910 South Main Street
South Bend, Indiana

"You can do it better with Gast"

CAM3-Gray

Clean your Condenser Tubes by Scouring

It takes less time

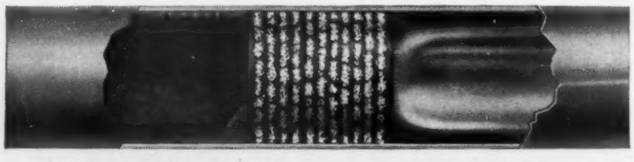
Another New Garlock Product

The Garlock Cord Plugs are an innovation in condenser tube cleaning. They brush and scour the inside wall of the tube. The ends of the many staggered cords extending beyond the cyclindrical wall of the plug sets up a frictional resistance to the inside surface of the tube. The plug shot through the tube by compressed air, working under the resistance, scours the inside surface down to the bright metal. It never leaves a film that retards the heat transfer.

The Factory Mark of a Product Made by trained Craftsmen

Garlock Cord Plugs are manufactured of tenacious resilient rubber and many long brush cords. The cords are insulated from each other by a rubber film. This prevents internal friction and gives long life to the plug.

Write for circular containing articles describing the method of cleaning with cord plugs and giving blue prints and instructions for making air gun to shoot the plugs. Sample plugs will also be furnished on request if outside diameter and gauge of tube is given.



When Garlock Cord Plugs are used for Condenser Tube Cleaning. The guaranteed vacuum can be maintained. The life of the condenser tubes prolonged. The condenser outage hours greatly reduced.

GARLOCK CORD PLUGS
for CLEANING CONDENSER TUBES
THE GARLOCK PACKING COMPANY, PALMYRA, N. Y.
Manufacturers of "Quality Controlled" Mechanical Packings

"Out-speeds, out-digs, out-travels and we are sure out-lasts all of them"

After running their first Gas+Air BUCYRUS-ERIE day and night for seven months, the Brown Constr. Co., of Sacramento, Calif.

bought another Gas+Air

"Bucyrus" and "Erie"—each the most successful manufacturer in its particular field—consolidated Jan. 1, 1928. The unmatched resources of BUCYRUS-ERIE assures the buyer of Unequalled Value, More Efficient Machines, Permanence of the Manufacturer, and a More Complete Field Service.

And they write: "This machine has done so well for us that we are always glad to broadcast its merits. Our rock excavation is extremely tough lava—hard on machinery, and another shovel on this work showed a very excessive upkeep cost. But the parts bill on this Gas+Air BUCYRUS-ERIE has been extremely satisfactory.

"This month, running three shifts as a dragline, our estimate was over 40,000 yards. The Gas+Air BUCYRUS-ERIE out-speeds, out-digs, out-travels, and we are sure will out-last any of them."—*Brown Construction Co., Sacramento, Calif.*

And have since bought another Gas+Air—

Because they have found that this machine's direct-connected crowding and swing engines give unequalled speed on shovel work—and that the air operated swinging engines give much bigger output on dragline work too.

Note what they write about low upkeep. This machine has the Bucyrus-Erie reliability.

Repeat orders for Gas+Air Bucyrus-Erie tell the story!

BUCYRUS-ERIE COMPANY

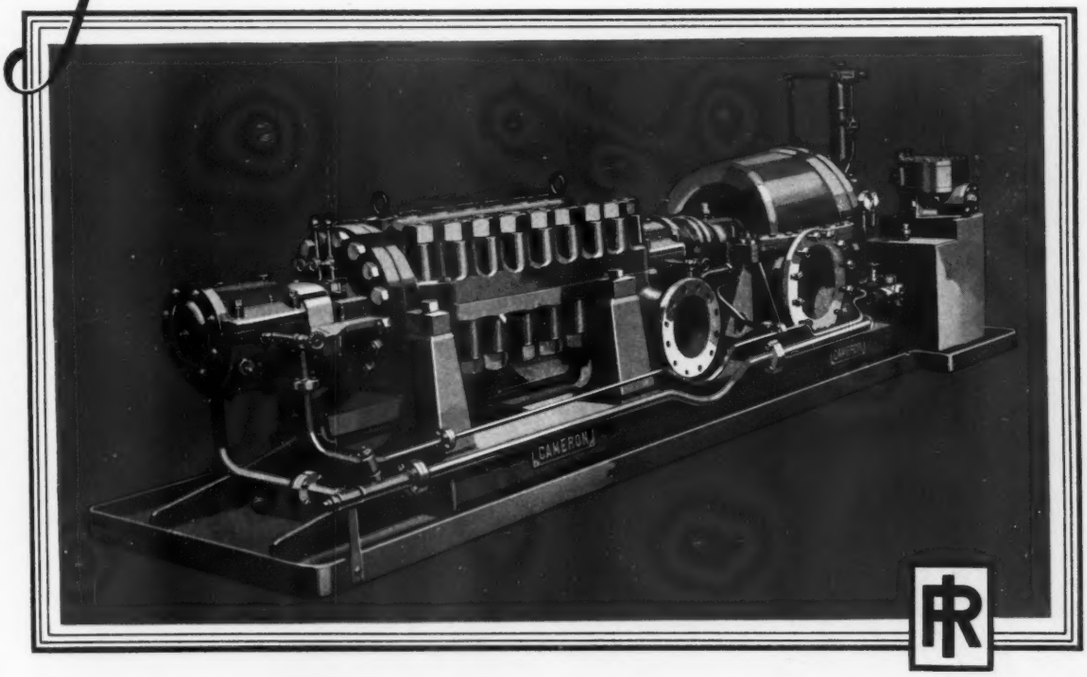
South Milwaukee, Wis.
Erie, Pa.
Evansville, Ind.

BUCYRUS ERIE

Branch Offices and Representatives Everywhere

The Cameron HT Centrifugal Pump

"The Highest Expression of the Pump Builder's Art"



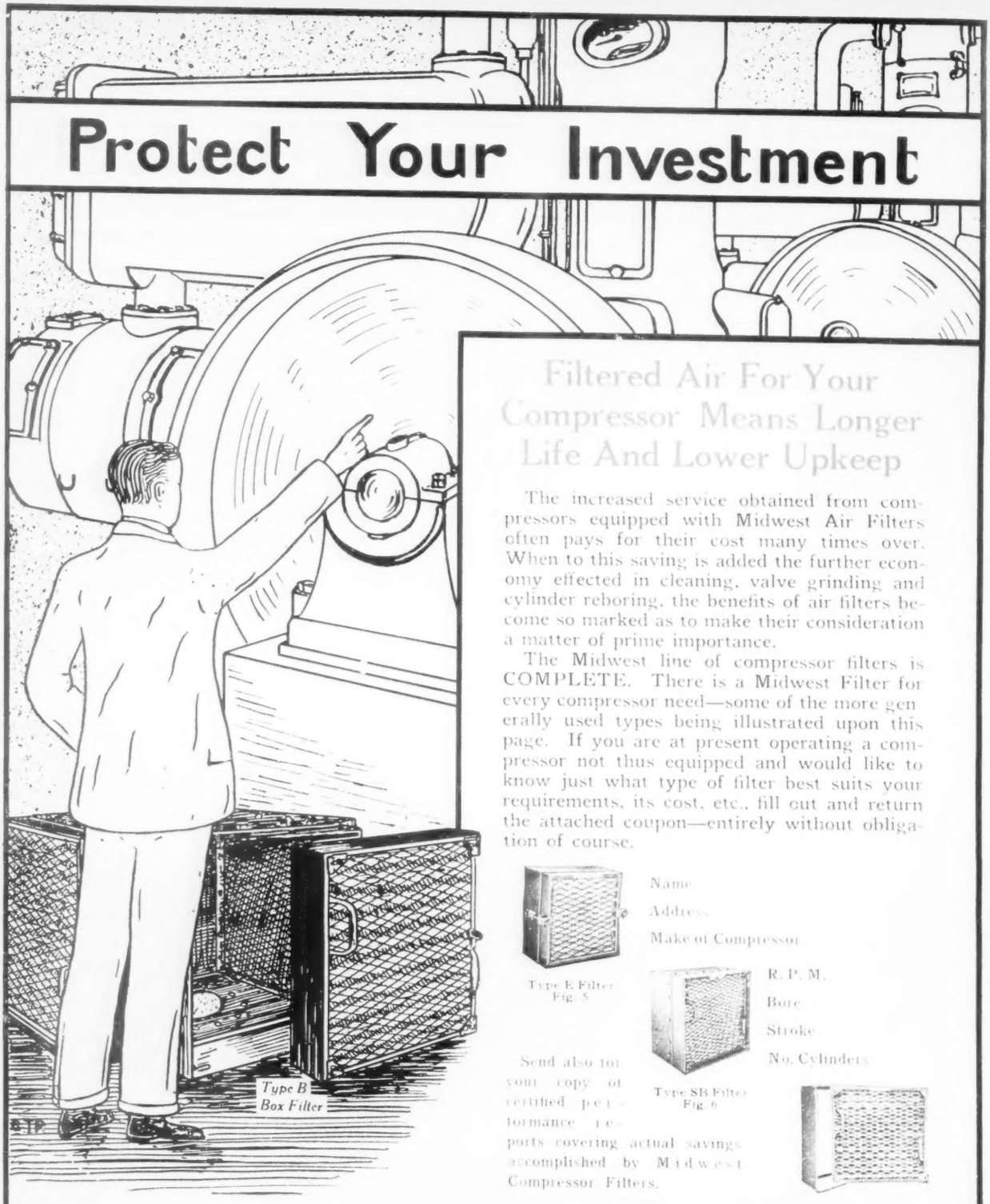
Now available in capacities up to 2000 gallons per minute and for Pressures up to 2000 lbs. per sq. inch

292-DV

Cameron Pumps

11 BROADWAY, NEW YORK

Protect Your Investment



Filtered Air For Your Compressor Means Longer Life And Lower Upkeep

The increased service obtained from compressors equipped with Midwest Air Filters often pays for their cost many times over. When to this saving is added the further economy effected in cleaning, valve grinding and cylinder reboring, the benefits of air filters become so marked as to make their consideration a matter of prime importance.

The Midwest line of compressor filters is COMPLETE. There is a Midwest Filter for every compressor need—some of the more generally used types being illustrated upon this page. If you are at present operating a compressor not thus equipped and would like to know just what type of filter best suits your requirements, its cost, etc., fill out and return the attached coupon—entirely without obligation of course.

Type E Filter
Fig. 5

Name

Address

Make of Compressor

Type SB Filter
Fig. 6

R. P. M.

Bore

Stroke

No. Cylinders

Send also for your copy of certified performance reports covering actual savings accomplished by Midwest Compressor Filters.

MIDWEST AIR FILTERS

INCORPORATED

BRADFORD, PA.

Offices in Principal Cities